THE

ELECTRICAL REVIEW.

VOL. LVII. SEPTEMBER 22, 1905. No. 1,452.

ELECTRICAL REVIEW.

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THE

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OLYMPIA.

OLYMPIA is a scene of great activity—indeed, of enthusiam it is said—just now in preparation for the opening of the electrical exhibition. Let us express a pious hope that by Monday next when the Lord Mayor performs the inaugural ceremony and the Electrical Volunteers, as announced to-day, are lending additional picturesqueness to the scene, the packing case and stand erection stage will have been passed through, and that there will be in evidence a finely-displayed collection of modern electric illuminating, heating, power and other machinery and appliances, which will worthily represent the science and engineering of electricity as they stand at this date. The exhibition cannot be representative of all sections of electrical engineering—it was never intended to be that; electric tramway and railway manufactures have, however, had a good run already this year, at the Agricultural Hall. The *raison d'être* of the Olympian Show is to popularise the supply of electricity for domestic and commercial purposes with the general public, who are at one and the same time the possible clients of the electricity supply companies, of contracting firms, and manufacturers, and of vendors of electrical supplies. Let us hope that this purpose will be accomplished to the full; then a fresh impetus will be given to various sections of our industry, and gas engineers will get back to the paths of humility along which they wandered vacantly before the holding of the Earl's Court Gas Exhibition.

We remember that when the National Association of Electrical Manufacturers was in labour with the scheme for this Exhibition, the manager of one of our large manufacturing houses remarked that if an exhibition continued open for a too lengthy period there would be no likelihood of a continuity in the flow of visitors—that following the opening there would be a drop in the curve, then a long low line, and, finally, a jump up for the closing few days. It was like that at the time of the last great Electrical Exhibition held in this country—that which took place at the Crystal Palace in the early months of 1892. That mistake has not been committed on the present occasion, and if the multitude of attractions are in full swing at Olympia next week, there should be no difficulty in maintaining the interest of the public throughout the entire short period of a month. Certainly it will not be for the want of publicity if the Olympian show is not a complete success.

While Olympia may be primarily a resort for the general public to wend their way to for the next few weeks, it will also be a meeting place for a large number of electrical men who will want to turn the opportunities for business to good account, and others who will want to see for themselves the latest things out. Most readers of the ELECTRICAL REVIEW within easy reach of London will doubtless be there once or twice during the run—indeed, none is so busy that he can afford to stay away, and no electrical man knows so much that he would not come away knowing more—and if we can render any little courtesies at our own stand our friends are welcome to make use of us.

TECHNICAL CLASSES.

The receipt from various Technical Institutes and Polytechnics of prospectuses of day and evening classes is a reminder that the students' summer is over, and that the hard work of winter is again before them. To the strenuous man of affairs, the wear and tear of business life, which tends, year by year, to become more and more absorbing, is scarcely less trying in summer than in winter.

To the technical student, however, the summer means relaxation and recreation; the winter, hard work and close application. If, in the term "student," we include those apprentices and mechanics, who, after a laborious day's work in the shops, seek, by attending technical night-classes, to fit themselves for more skilled and more lucrative positions than otherwise they could hope to fill, these also have before them the prospect of long winter nights of study as well as the dark, cheerless mornings of toil.

It can hardly now be said, as it was a few years ago, that there is in this country any lack of technical training schools, although there may be found those who question the efficacy of the training.

What is the best kind of technical training for an electrical engineer student? This is a question which has been asked over and over again, and answered in various ways, more or less convincingly according to the point of view from which the subject is regarded.

From the point of view of the academic professor, a three years' technical college course is the first and most important essential; the engineering employer, on the other hand, holds that the practical training of a workshop apprenticeship is at any rate of equal, if not greater, importance. It is, however, admitted by those whose opinions carry most weight, that technical college and workshop training both have their proper places, and the only outstanding question is the correct apportioning of these two quantities.

Considering for a moment the technical college side of the question, there appears to be an idea that a stereotyped course of lectures, based apparently on the City and Guilds syllabus, is sufficient to meet the individual requirements of every student. For day students taking the regular three years' course this may be all very well, as these men need such a general knowledge of electrotechnics as will enable them afterwards to specialise in any direction.

But the night-class men are different. As a rule, they are men who are engaged in practical work in the daytime, and they come to hear something which bears directly upon that work—something which will help them to become better workmen, using the term in its broadest sense. They do not come to hear a sermon—a dreary recital from the pages of some text-book which might with equal, perhaps more, profit, be studied at home—they prefer to listen to a man who has gone through the mill, who knows his work, and is enthusiastic about it.

It is argued that technical schools are not established for the purpose of teaching trade or handicraft; but they are surely justified in teaching applied electricity as well as the crude principles. There would appear to be room in many of our technical institutes—judging from the prospectuses we have seen, and also from our own experience—for a class on applied electricity. The electrical engineer who has his living to make needs to know a great deal more than the elements of electrotechnics, seeing that his work enters so largely into all other departments of engineering. The driving of dynamos by steam, oil or gas engines, the size and duty of boilers, the quantity of gas, water, or oil required; gas producers; water turbines, and how to estimate the power of water; pumps, the best type to use, how to drive them, the power required, and the precautions necessary; methods of driving machine tools and machinery of all kinds; steam and exhaust pipe arrangements, and the methods of using exhaust steam for heating or boiling purposes—these, and the countless practical problems that form part of the day's work of the electrical engineer, are points which can only be successfully taught by a man of wide experience who has actually dealt with such cases.

Is this the kind of man whom our technical colleges seek to retain as teachers? Except in isolated instances, this does not appear to be the case.

To judge from the advertisements for teachers in electrical engineering which appear from time to time in our columns, we fear that the salaries offered are not sufficient to tempt experienced engineers to take up teaching work, and the natural result is that technical teachers are, as a rule, men who, however brilliant their academic careers may have been, are not men who have been brought into close touch with the practical and business side of the engineering profession, and are, generally speaking, without a spark of enthusiasm.

And herein lies one of the weak points in our present system of technical education.

Candle-Power Ratings.

In its issue for September 2nd, the *Electrical World and Engineer*, New York, makes some pertinent editorial remarks on the need for seriously considering the question of rating the candle-power emitted by the several electric lamps now on the market—a subject which was under discussion at the recent convention of the Ohio Electrical Association. Now that there are so many types of lamp on sale, to wit, the ordinary incandescent carbon lamp, those with the new graphitised (metallised) carbon filament, the osmium lamp, the tantalum lamp, the Nernst lamp, the mercury vapour lamp, and the numerous variety of arc lamps, the problem of measuring the relative efficiencies becomes one of a decidedly complex nature, seeing that each has its own peculiar shape and colour. The relative practical efficiency of some of the lamps enumerated was, it appears, under animated discussion at the meeting, by the representatives interested in exploiting the different types of lamp. The practice of rating the efficiency of a lamp by measuring its candle-power when placed so as to give a maximum of light is very convenient from more than one point of view, but it manifestly gives erroneous results. The best scientifi method—the one specially advocated by our contemporary—is to measure the mean spherical candle-power, but even this procedure is open to several objections and difficulties. Some lamps lend themselves to this method of measurement reasonably well; with others, such as the Cooper-Hewitt lamp, serious difficulties are involved. Further, it is contended by many, and with sound reason, that the mean spherical efficiency does not furnish a commercial basis for comparing different illuminants, since light is often needed in special directions, and since, in many cases, the light, in certain directions, is wasted so far as practical illumination is concerned; also, because in some cases reflectors, or diffusing globes, are needed in order to bring out the best possible efficiency. The question of colour, moreover, is a material and complicating feature in estimating the commercial efficiency and value of a lamp, the light of one lamp being better adapted to view certain articles than that of another. Various attempts have been made from time to time by the National Electric Light Association and other bodies to deal with the question of candle-power rating, but so far with no very definite result. Our contemporary deems the time to be now ripe for the question to be seriously tackled by some Association or authoritative body, whose task would be to decide upon a rational and definite system of measurement. If such a body be appointed, the experts delegated to consider the subject will have a confusing (let us trust not a hopeless) problem to deal with.

THE INTERNATIONAL EXHIBITION AT LIÉGE.

The Liége International Exhibition was officially opened on April 27th, 1905. Liége forms the centre of the Belgian industrial district, and was, therefore, well chosen as the seat of this Exhibition, which, by the way, is being held in commemoration of the 75th anniversary of Belgium's Independence.

The Machinery Halls form part of the main building in the "Vennes" department of the Exhibition, and cover an

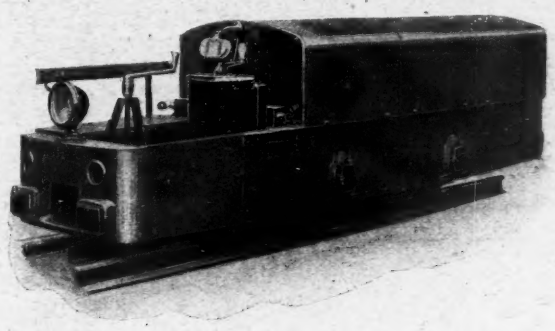


Fig. 1.—Electric Accumulator Locomotive.

area of about 36,000 square yards, which includes the space occupied by boilers, gas producers, and the railway materials exhibited.

Besides this, some 6,000 square yards are taken up by all kinds of machinery, scattered over various parts of the Exhibition.

There are in all eight overhead travelling cranes, all electrically driven, and the four largest are built for a load of 30 tons each.

The electrical supply consists of a continuous current at 440 volts, and is distributed on the three-wire system. Machines aggregating some 1,200 kw. supply the usual load, and a large number of other sets are acting as stand-by. These machines are situated in the centre of the Belgian section. The main switchboard is at one end of this section, and consists of 15 marble panels.

An interesting exhibit is a Diesel engine, made by the Société Anonyme des Ateliers Carels Frères, of Ghent. This machine is built for an output of 500 h.p. at 150 r.p.m., and is direct coupled to a Lahmeyer generator, which supplies current to the exhibitors. The engine has three cylinders, the three cranks being placed at an angle of 120° from each other.

Forced lubrication is used for the piston and piston rod, and automatic ring lubrication for the bearings. The temperature of the cooling water is kept at about 70° C.; as is usual with this type of engine, compressed air is used for starting, only two of the cylinders being used for this purpose. The fuel consumption is most economical, crude Texas oil of specific gravity 0·925-0·930 being used.

Messrs. Carels Frères state that this is the largest Diesel engine built, so far, but that they have already sold upwards of 100 similar but smaller engines, a large number of orders coming from England.

The same firm is exhibiting a 600-h.p. compound horizontal steam engine, running at 110 r.p.m. This type of engine is specially built for electrical driving. Notwithstanding the comparatively high speed, the drop-valves work perfectly noiselessly, both exhaust and admission valves being driven off the same eccentric sheave. Speed regulation is obtained both by hand and by the governor, by varying the cut-off on the high pressure cylinder. This engine also is direct coupled to a dynamo supplying current to the Exhibition, the latter being a standard machine of the Ateliers de Constructions Electriques de Charleroi.

This firm has a separate stand close by, and is exhibiting various types of electrical machinery.

In the centre of the stand there is a 70-h.p. low-speed three-phase induction motor, intended for driving a mining pump, and wound for a pressure of 2,000 volts.

The slip-rings, and the short-circuiting and brush lifting-device, are entirely enclosed, the handle of the latter and the three cables alone protruding from the iron case. Other machines shown are a 25-h.p. and a 35-h.p. tramway motor, both with complete gear, and a number of continuous current and single and polyphase standard motors. The single-phase motors are provided with the well-known Heyland starting device.

Fig. 1 shows an electric locomotive driven by accumulators, intended for coal mine work, and also exhibited on this stand.

The mines of La Société des Charbonnages d'Amorcocur, of Jumet, have been equipped throughout with locomotives identical with this one, and they have proved exceedingly satisfactory and very economical in comparison with the horse traction previously in use. The gauge employed is 1 ft. 9½ in. The work consists of hauling a train of 20 loaded trucks, weighing 13½ tons, down an incline of 1 : 330, and returning with the empty train, weighing 5½ tons, at the same speed of 6 miles per hour on a 1,640-yd. route; 16 return journeys are made on one charge.

The battery is placed in the back part of the locomotive, and is specially designed to stand rough handling. It consists of three sets of 12 cells each, placed in wooden tanks lined with lead. The capacity is 350 ampere-hours, and the normal rate of discharge is 70 amperes. The complete battery weighs close on 3 tons, this being about half the total weight of the locomotive.

There are two 6-h.p. four-pole motors, entirely enclosed, damp and dust proof. On account of its small width the armature is ring-wound. The yoke is cast in two halves, which are joined by hinges on the side opposite to the axle. This arrangement enables the motor to be taken to pieces in the shortest space of time. Both brush-holder studs are fixed to the lower half of the carcase, which is also provided with a detachable cover to allow for inspection. The illustration shows the position of the controller and the hand-brake, which acts on all four wheels. A combined volt and amperemeter is also provided. As will be seen, the whole locomotive has a compact and workmanlike appearance.

Another Belgian firm, whose work is well known in this country, is the Compagnie Internationale d'Electricité, of Liége. The following are a few of the machines exhibited on their stand:—Two balancers, ordered by the State, for 120 amperes at 220 volts each. A motor-generator converting three-phase current at 3,000 volts and 50 periods to

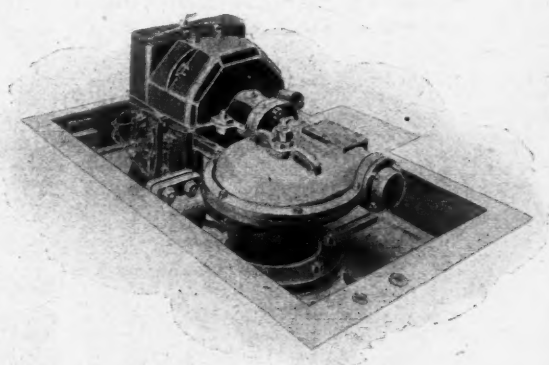


Fig. 2.—Electric Capstan, Inverted.

continuous current at 220 volts, the output being 60 kw., and the speed 720 r.p.m. A lathe, directly driven by a three-phase variable speed motor, is also of interest; three speeds may be obtained by varying the number of poles of the motor. A very compact electrically-driven capstan is installed. To start the motor, the attendant merely presses a pedal, and by that means starts the automatic starting resistance, which is also exhibited, and has five separate contact switches. The whole arrangement is mounted on an iron plate, and as it is held in position by means of two horizontal pivots, it may be entirely inverted for inspection when the four catch bolts are loosened. Fig. 2 shows the inverted capstan. The motor is an 18-h.p. com-

pound machine. Thirty-six of these capstans are installed at the port of Antwerp, and a number are on order.

Of several generators exhibited by this firm, it will suffice to mention a 400-kw. dynamo which has been bought by the State, and is direct-coupled to a steam engine made by Messrs. Van den Kerchove. The firm also supplied one of the above-mentioned 30-ton overhead travellers. The crab is fitted with two lifting devices, one for 30 tons and one for 6 tons, each worked by a 30-h.p. series motor. A special feature of this crane is that for travelling there is a motor at each end controlled by the same starter, thus doing away with a considerable length of shafting.

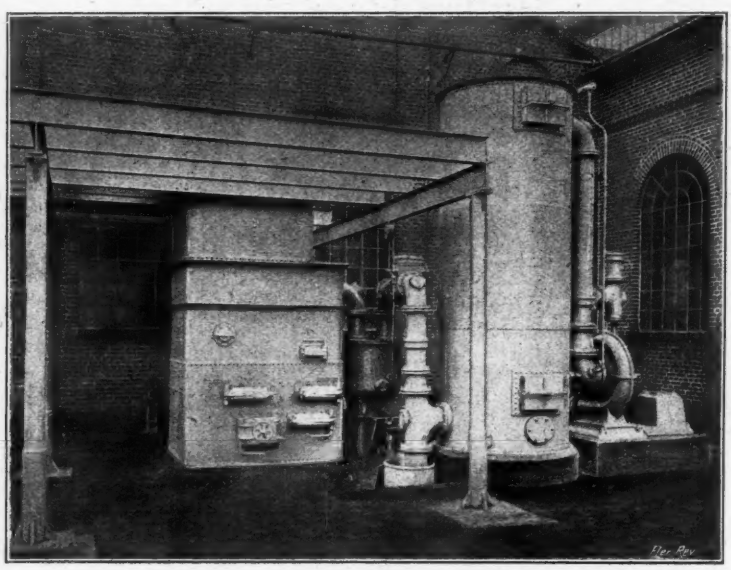


Fig. 3.—Gas Producer for Bituminous Coal.

Undoubtedly the largest machines are being exhibited by Messrs. John Cockerill, of Seraing. They are showing a 1,200-h.p. gas engine built for furnace gas, and a 500-h.p. engine for coke-oven gas. The larger engine is intended for driving a rolling mill, and the smaller one is direct coupled to a dynamo built by the Compagnie Internationale d'Electricité. The cylinders of the 1,200-h.p. engine are 3 ft. 3½ in. in diameter, and the stroke is 3 ft. 7½ in., the speed 100 r.p.m. There are two tandem cylinders, whereas the two cylinders of the 500-h.p. engine stand side by side. The Cockerill gas engine is being made in this country by Messrs. Richardsons, Westgarth & Co., of Hartlepool, and a few details of the type may prove of interest. Besides the above-mentioned tandem and twin types, there are also single-cylinder engines for smaller output, and tandem twin engines for 5,000-6,000 h.p. All the engines are double-acting, and work on the Otto cycle, so that with the largest types four explosions per revolution are obtained, thus ensuring a very small fluctuation of speed, with a minimum weight in the fly-wheel.

The valves are operated by a shaft, which runs alongside the engine, and is geared to run at half the speed of the crank-shaft. The inlet valves are above, and the exhaust valves below, the cylinders. The engine is governed by varying the quality of the explosive mixture, the compression being kept constant. To vary the mixture, the governor regulates the period during which the gas valve is kept open. Each cylinder is cast in one with its water jacket. All parts that come in contact with the hot gases are water-cooled, and the temperature of the water, when leaving the engine, is not allowed to exceed 50° C. If the water enters at a temperature of 15° C., about 11·2 gallons per b.h.p.-hour will be consumed. A pressure of about 1 atmosphere suffices to ensure efficient circulation.

The main bearings are provided with ring lubricators, and for the cylinders forced lubrication is used. The oil consumption is said to work out at about 1 dram per b.h.p.-hour. For satisfactory working, it is essential that the gas should be free from tarry matter, and, as far as possible, from dust also. Gas containing more than, say, 0·05 grain per cb. ft., will necessitate frequent cleaning of the cylinders and valves, and is bound to reduce the life of the engine. Compressed air is used for starting, and works on one side of the piston, until the first explosions take place on the other side. A special little air compressor is required for this purpose, and that used for starting the 500-h.p. engine is driven by a 5-h.p. electric motor. Magneto-electric machines are used for igniting the compressed mixture, and this system seems to be superseding all others, at least as regards the larger types.

As regards mechanical arrangements, the Cockerill engine is very similar to those made by the Gasmotorenfabrik Deutz, of Deutz, near Cologne, the original holders of the Otto patents. Those of our readers who visited the Düsseldorf Exhibition in 1902 will, no doubt, recollect that firm's excellent exhibits. At Liége they are again showing engines, varying in size from 2 to 250 h.p. The largest of these runs at 136 r.p.m. The piston diameter is 1 ft. $10\frac{13}{16}$ in., and the stroke 2 ft. $5\frac{1}{8}$ in. The patent regulator keeps the proportions of gas and air constant, but varies the quantity admitted. Provision is made for cooling both the cylinders and the pistons with circulating water, but of course the smaller single-

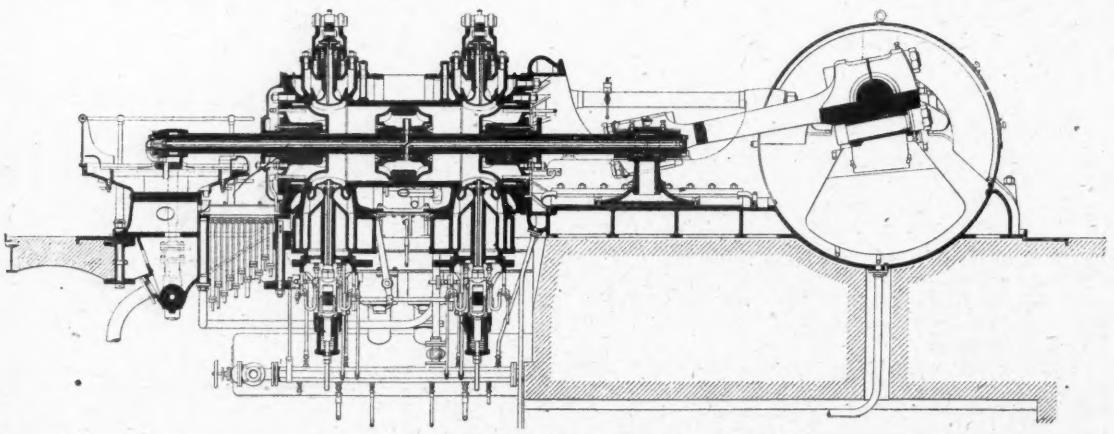


Fig. 4.—Section of Union Gas Engine (See p. 449).

acting engines do not require to have their pistons cooled by water.

The smallest engine represents a type made up to 5 H.P. These small engines have been made for the last 10 years, without the type having to undergo any alterations to keep it up to date. A 35-H.P. engine driving a horizontal pump represents a new type of engine, whose characteristic is simplicity of construction and absence of all unnecessary external finish. This engine gets its supply of gas from a Deutz anthracite suction gas generator.

The gas used for the other engines is supplied from the producer shown in fig. 3, which stands just outside the Hall. It is primarily intended for briquettes of low grade bituminous coal with as low a calorific value as 3,000 to 7,000 calories per kg. The generator is fired simultaneously from the top and bottom. It is fed from the top, which is left partly open, and in the fire all tarry matter is decomposed. On leaving the generator the gas passes through a scrubber, and thence straight to the engine. When starting the generator, an exhausting fan is used until good quality gas is obtained. This fan is stopped when the engine is at work.

Another German works showing a gas engine is the Maschinenbau Gesellschaft Union, of Zossen on the Ruhr. The engine is built for an output of 500 H.P., at 150 r.p.m., and works on the Otto cycle. Fig. 4 shows its general arrangement and dimensions, and it will be seen that the engine is double-acting. The whole of the valve-gear, including the ignition, is worked off a single eccentric on each side of the cylinders.

The patent governing arrangement is said to give very satisfactory results. The shaft governor is driven by an extension of the crankshaft, and regulates the quantity of gas taken in and also the gas-air mixture by means of throttle valves, but the quantity of air is governed by a slide valve. The gas and air are mixed in an automatic valve with a dash-pot action. The point of ignition is also governed so that at light loads and poorer mixture, the ignition is earlier. The governor rods are balanced and move in ball bearings, avoiding back pressure on the governor.

(To be continued.)

THE BRUSH COMPANY'S STEEL RAILWAY CAR.

On Monday last, through the courtesy of the Brush Electrical Engineering Co., Ltd., we were enabled to inspect what is claimed to be the first British-built steel railway car, supplied from the above company's Loughborough works, for use on the Great Northern, Piccadilly and Brompton Railway.

The car is the forerunner of some 18 similar ones to be supplied by the same firm. It has seating accommodation for 52 passengers on either side of a central gangway.

The framework is of steel, as also are the sides, roof and ends of the car. The window, door and seat fittings are of non-inflammable wood, as generally adopted on the Metropolitan and District Railways.

The car, which we illustrate herewith, is externally finished in scarlet and white, and in shape resembles the ordinary tube stock.

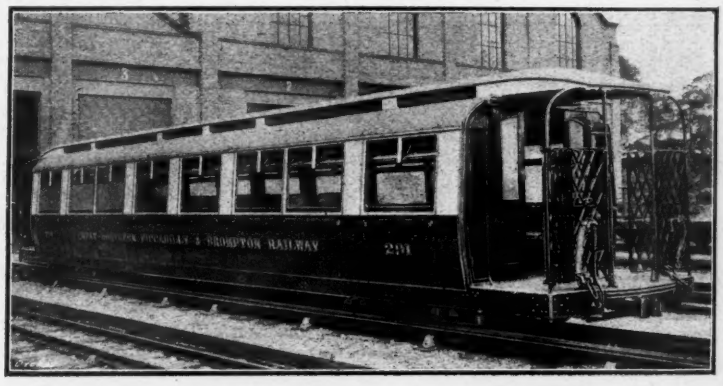
The advantage of employing fire-resisting material on underground electric railways needs little emphasising on our part; the principle of such construction has been recognised on all the recently opened electrical lines, and most certainly ought to be on our main-line railways.

The Brush Co., although fully equipped for turning out non-inflammable timber coaches, has, as the result of experiment, decided in favour of the all-steel coach for the future.

In addition to its immunity from fire, it represents a large saving in dead weight per passenger carried, and this, in turn, means a saving in the costs of propulsion.

The latter is estimated at £25 per ton on the London underground lines, and a saving of 3 tons per car is therefore equivalent to £75 a year added revenue per car—no inconsiderable item in the present days of vanishing dividends.

The company estimate a saving of some 20 per cent. in weight as compared with the normal wooden railway coach, and in this connection the following comparative figures will be of interest:—



Great Northern, Piccadilly and Brompton Steel Car.

Details.	Great Northern and City Railway.	Metropolitan District Railway.	Gt. Northern, Piccadilly and Brompton Railway. Steel coach.
	ft. in.	ft. in.	ft. in.
Length over body	40 8	35 8	41 8½
Length over platforms ...	49 6	49 9½	49 9½
Width over pillars	9 4	8 9	8 8
Extreme width	9 4	8 10½	8 9
Height from floor to roof ...	8 6½	8 5	7 6
Height from rail to top ...	12 4½	12 3¾	9 5⅜
Wheel base	6 1	6 6	5 0
Bogie centres	34 6	33 10½	33 0
Diameter of wheels ...	3 0	Motor, 3′ 0″ Trail, 2′ 6″	2 6
Seating capacity	58	52	54
	tons. cwt.	tons. cwt.	tons. cwt.
Weight	18 16	21 5	15 17
Weight per passenger seated	726 lb.	918 lb.	657 lb.
Cost of energy per coach per annum at £25 per ton	£470	£530	£396

The new coaches are being built to the designs of Mr. G. C. Cuningham, the general manager of the Central London Railway, who has had experience with six American-built steel cars on his own line.

Judging from the fact that 18 steel cars are being constructed at Loughborough for the Great Northern and City Railway Co., and that negotiations are on hand for 34 steel tramway cars for the L.C.C. Kingsway route, the Brush Co.'s favourable anticipations in regard to their latest venture appear to be more than justified.

OUR LEGAL QUERY COLUMN.

[*Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.*]

"Weston" writes:—"A, an electrical contractor, was carrying out considerable electrical work for B. C, the representative of a wholesale house of fitting manufacturers, called on A, and was instructed to go and see B as coming from A, and submit his illustrations of electroliers, &c., as B wanted some. C was distinctly told not to forget A's trade discount. Nothing of prices, &c., was discussed. C called as instructed, and stated he was told to by A, but appears to have given B the full trade discount, mentioning that A did not want anything on the order. C's employers refuse to give A a single penny on the order that was secured on the above grounds. Can A recover in Court? There was no reason whatever to give B any discount. The order was given by B direct to C, and the invoice was rendered by B to C, and after A's consent was obtained was duly paid."

*** It is not altogether clear upon the above statement of facts what it was that A gave his consent to as stated in the last line. If A assented to B having the full discount, A cannot now claim anything from C. It may well be, however, that the consent referred to merely related to the delivery of the account. In that

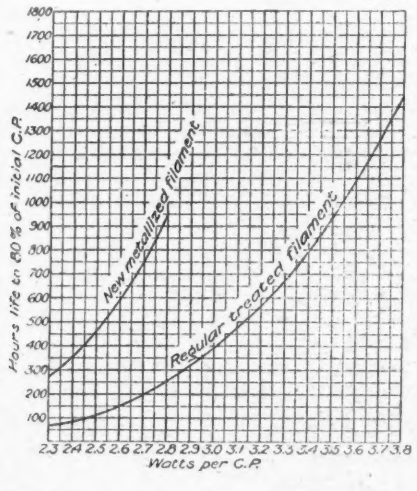
case it is apprehended that the facts stated are sufficient to raise an implied contract on C's part to pay a commission to A. A should consult a solicitor.

"A. G." writes:—"I should like to ask you through the medium of the Electrical Review:—Is a public supply authority bound to give a supply where the same is to be used only as a stand-by to a private generating plant, and are they entitled to make any charges other than that for the actual current consumed?"

*** There is nothing in any public Act of Parliament to prevent a consumer using electricity supplied from the mains of a supply authority as a "stand-by" in the manner suggested. In certain districts supply authorities have secured the insertion in their provisional orders of clauses which place consumers who use the public supply as a stand-by on special terms; but no such provision applies in the district from which "A. G." addresses his communication.

THE EFFICIENCY AND LIFE OF THE METALLISED FILAMENT.

As long ago as 1888 Mr. J. W. Howell, in a paper read at the American Institute of Electrical Engineers (noticed in our issue for June 21st of that year) gave a curve showing the life of Edison lamps, with "untreated" bamboo carbons, when run at different efficiencies. Since those days considerable improvements have been effected in the Edison lamp. A paper has recently been read by Mr. F. W. Wilcox before the Ohio Electric Light Association, which was briefly noticed by the *Electrical Review* (N.Y.), from which we reproduce the annexed curves. These show the useful life of lamps, run at different efficiencies, (*a*) with ordinary treated filaments, (*b*) with the new



metallised filaments, which latter were described in our issue for August 11th, 1905. The curve of the lamps with "treated" filaments is steeper than the old curve referred to, and it is interesting to see how much steeper again is the curve obtained from the life tests with metallised filaments. It should be noted, moreover, that the curves indicate not the life of the filaments, but the *useful* life of the lamps, *i.e.*, run to 80 per cent. of their initial illuminating power. The economy of the now familiar "smashing point" policy had not properly dawned in 1888.

The voltage and candle-power of the lamps employed in the tests are not stated.

CENTRAL STATION DESIGN: AN EXACT SCIENCE.

(COMMUNICATED.)

An American writer has counselled the youth of his own and succeeding generations, as follows:—"Aim high, you may not hit what you aim at, but you will shoot the higher for the aiming." It is the privilege of youth to bestow a certain amount of time and energy on the attempt to realise the ideal, and truly the world would be a less interesting place in which to live, if this were not the case. When, however, this attitude of mind is exhibited by older men, and in the sphere of business, it lays itself open to adverse criticism, as having strayed out of its legitimate field of poetry or philosophy. Occasionally, even in the prosaic routine of central station work one comes across what would appear to be manifestations of such a tendency, and in this case the results are likely to conduce to unproductive extravagance.

It is still, apparently, an unsettled problem in many minds, whether a public generating station shall be regarded strictly on business lines as a revenue-producing concern, or whether it shall be a sort of exhibition, attempting, and often with too great success, to cover the utilitarian with a cloak of æstheticism. Perhaps it is not altogether an advantage that the electrical industry should lend itself so aptly to æsthetic treatment, insidiously flattering the *amour propre* of the members of our local authorities, and stimulating them to financial recklessness. There is beauty, no doubt, in a wonderfully swept and garnished engine room, but one would also point out the attractiveness of a favourable balance-sheet.

It is only to be expected that a commercial undertaking of such mushroom growth as is that of the generation and distribution of electrical energy, should provide instances of very varied arrangements resulting from the existence of widely different conceptions as to the object, and the means of attaining that object, of the industry.

Where progress has been so rapid, the interval between ancient and modern must inevitably be of short duration, and the reign of one type of apparatus must be superseded almost immediately, owing to the evolution of newer ideas. So much has this been the case that engineers have rushed from one extreme to another, forgetting in many cases the claims of the older type in the attractions of the new. As a natural result, many of our modern power stations (if a station may be regarded as modern after having been in existence ten years) present a most extraordinary conglomeration of plant, mechanical and electrical, of all sizes and shapes.

It is, however, a task of no great difficulty to be wise after the event, to indicate early mistakes in the light of present wider knowledge, and the points proposed for consideration here consist not so much in the choice and arrangement of a type of plant as in a glance at the general aim and the clearness of vision with which efforts have been directed towards it. Neglecting the æsthetic point of view above referred to, and omitting from our inquiry such stations as exemplify it, we may presume that, in the generality of cases, the main objects sought are efficiency and economy. Let us see how these laudable aims are in course of achievement. We need not go to older stations for examples—our present-day works, now in course of erection, will yield sufficient matter for a short inquiry.

It has been said, and perhaps with some degree of truth, that "Consistency is the bugbear of small minds," and one is inspired to hope that herein lies the explanation, difficult to find otherwise, of the very large number of inconsistencies exhibited in the average specification for plant. Who has not seen specifications calling for a definite steam consumption to the second place of decimals, while the methods sometimes selected for ascertaining whether the guarantees have been attained may themselves be questioned as to accuracy within 5 per cent.? Of what conceivable service can be the guarantee of combined efficiency of a generating set, when the only method of checking it involves the use of the indicator, itself subject to a possible error of quite this amount?

Whether or not the engineers responsible for these and other similar anomalies can take shelter under the quotation mentioned, it may be argued that the question at issue is not so much one of consistency as of another commodity of a much more ordinary kind—viz., common sense.

In a recent specification which came under the writer's notice, several switchboard instruments of various types were called for. The ammeters reading from zero to 2,000 amperes were required to have an 8-in. scale, and to be accurate within ·5 per cent. throughout the range of the instrument. It is a simple calculation to see that the

pointer must be true to its position within an amount not exceeding $\frac{1}{25}$ of an inch at all readings, while the needle itself would, in an instrument of this size, be probably nearly $\frac{1}{16}$ in. broad at the point. The voltmeters, and also the wattmeters, were required to come up to an equally unattainable standard, and it would appear that the engineer was not satisfied that his conditions were even then sufficiently stringent. To give still further evidence of misdirected zeal it was specially required that the errors must be inclusive of any temperature effect; and finally, the ammeters were carefully placed within 6 in. of large bus-bars, on which the current would vary in intensity from almost nothing up to 4,000 or 5,000 amperes.

The precise object of all this is not quite clear, and one cannot help wondering whether some latent vein of humour has not been rather expensively indulged, to the discomfiture alike of the instrument-maker and also of the station engineer. It is far from our present intention to decry or discredit exactness and accuracy; let us be exact by all means, but it is preferable to exhibit the quality in a rather more sane and less pretentious manner.

If such accuracy could be insisted upon and carried through all departments of central station plant, the works would, at any rate, be efficient, if perhaps somewhat difficult of operation. Unfortunately, however, it is usual to find that such laboured exactness in detail has had the effect of allowing very serious objections to occur in the general design of the plant.

The use of the microscope is said to deteriorate the power of the eye for ordinary vision, and it is to be feared that in close attention to the small and comparatively insignificant trifles in the arrangement, the broad lines of design are frequently neglected. It would appear that the sense of proportion becomes obscured, and the close scrutiny which should be given to the *tout ensemble* is bestowed only on some of the component parts.

The question of steam consumption of generating sets was referred to previously in the present article, and may well form the subject of a somewhat fuller consideration, as it is apparently a point far too much laboured. Of what advantage is it to the station engineer to possess combined sets where everything is cut abnormally fine to save a quarter of a pound of steam per KW.-hour on test, when his steam range condensation, steam-driven auxiliaries and leakage from joints are accountable for probably far more steam than is consumed by the actual generating plant itself?

It is to be presumed that most stations can generate from their machines at the cost of something like 25 lb. of steam delivered at the engine, per unit. On examining the records of these stations, we find that the average amount of steam required per unit throughout the year is in the neighbourhood of 50 to 60 lb., and in some cases considerably higher. To obtain the low steam consumption guarantee, engine clearances must be reduced to the finest possible limit, greatly increasing the liability to serious accident, and also, of course, the first cost, while, as is shown in the foregoing figures, the net gain, if any, to the station is practicably negligible.

In the steam turbine particularly, a prime mover for which there is undoubtedly a very wide field in the future, the clearance between rotor and case is made so slight with a view to the exaction of the last fraction in steam consumption, that one constantly hears of blades stripped through too rapid starting. It is difficult to see the use in a power station of a machine which may be very economical when running but which requires half an hour to one hour's warming up before it can be set to work, and in which a comparatively trivial amount of wear in a main bearing is likely to produce disastrous results. One is aware that this is rank heresy to most consulting engineers, but one still holds to the opinion that truer economy would be achieved by sacrificing the steam consumption guarantee, in increasing the clearances somewhat, and being able to take the 5.30 train home and cultivate a peaceful habit of mind.

It should be remembered that the first essential condition in our industry is absolute reliability of supply, and, secondly, economy of production, although we are far from admitting that such a slight sacrifice of efficiency as that contemplated would materially, if at all, affect the latter consideration.

There is another phase of the question which a station engineer rather shrinks from advancing, viz., the wear and tear of the engineer himself. The knowledge that his work is dependent on the maintenance of a 2 mm. clearance is not stimulating to reposefulness. It may be, if the present craze for the highest test-plate efficiency is maintained, that our municipal Cæsars will be exclaiming:—

> Let me have men about me that are fat,
> Sleek-headed men and such as sleep o' nights;
> Yond'—— hath a lean and hungry look.
> He thinks too much.

Another phase of the subject of anomalies in central station design is introduced in the installation of labour-saving machinery under conditions which cannot possibly result in economy. Such examples as fuel-conveying and elevating gear, and mechanical stoking appliances serve to illustrate this. Such apparatus would undoubtedly form a part, and a very valuable part, of the plant of a station operating under ideal conditions, but coming to the actual and dealing with load factors which are very far from ideal, they can in very few cases justify their selection on the score of economy alone. It is difficult to understand the attitude of mind of the Councillor who votes for such embellishments, and at the same time provides unremunerative labour for the unemployed section of his constituents.

Instances might be multiplied *ad infinitum* to advocate the cause of simplicity in station design, but enough has, perhaps, been said to indicate a train of thought worthy of more mature consideration.

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Some Arithmetical Questions for Mr. Byng.

I am neither a Free Trader nor a Socialist, and in theory I quite agree with Mr. G. Byng that the question of employment should be settled by the employer. But, unfortunately, human nature is a malevolent factor. What, for instance, is to prevent a manufacturer, whose income is temporarily affected by the state of the market, from *contributing to unemployment* by sacrificing employés who have served him faithfully for years, thereby thinking to recoup himself by engaging cheaper men? That this is done occasionally nobody will deny; it is, of course, immoral and "savours of serfdom." I put it to Mr. Byng that a system of protective tariffs would do little to benefit employés subjected to such caprices of manufacturers.

F. T. Talmadge.

Seaham Harbour, *September 16th*, 1905.

The Wiring Industry.

Your correspondents Messrs. R. J. Nicholson & Co. consider that my article of September 8th was not conclusive. Yet I gather from their letter that they agree with my main conclusion, which is—that really capable contractors, who thoroughly train and retain their workmen, and who show enterprise, ingenuity and resource, have no cause to fear that they will be crowded out of the electrical industry.

The only point they criticise is the suggestion at the end of my article, where I advised contractors to join their Association.

Your correspondents contend that the only way such combinations can influence prices is by the formation of a trust, against which they proceed to argue.

I did not advocate the forming of a trust; that may only be done successfully where opposition cannot be established without considerable capital. I cannot agree that an association has no other weapon.

Although many manufacturers and wholesale dealers in this trade are not content to do business as their like in other trades, but cater for the private customer, their chief business yet is with the contractor. If the contractors acting

together refuse to do business with wholesale houses which are also retailers, it is just possible that they may be able to secure fairer treatment. Even if they fail to do so an association can place combined orders ; or, if need be, manufacture, and so be enabled, as a body, to compete on equal terms.

The Association has already proved itself useful for adjusting various matters with trade unions, corporations, consulting engineers and others. It also tends to friendliness between members, and to the exercise of a certain amount of public opinion on members who engage in practices injurious to the trade.

I did not, however, defend the E.C.A. as a perfect organisation ; what I said was, let the best firms join and better it.

I have said already that the purpose of my article was not to further the Association referred to, it was intended rather for the encouragement of the legitimate and capable contractor, under a sentence of doom pronounced upon him by a previous writer.

Donald S. Munro.

Glasgow, *September 18th*, 1905.

That the position of the wiring contractor is departing from that which it occupied in its youth, is a fact which is to be regretted by those who were apprenticed to it, and also by the whole manufacturing trade. The fact that the local plumber, decorator, &c., is now doing his share of wiring is one which has done more to introduce the jerry wireman than any other, I believe.

In cities and large towns a wiring contractor's business is more likely of being a success owing to the greater scope available to obtain an all-year-round business, but in smaller towns, especially where the supply has been laid any length of time, it is a most difficult problem to compete with the local plumbing megohms, &c.

New work is usually included in the plumbers' contracts, and in a small town such a clannish spirit exists that the work is given because Mr. So-and-So has always done it. The plumber, &c., finding he has such work almost forced upon him, perhaps engages a wireman, and when work still comes in the wireman is expected to initiate the plumbers, and before long they imagine that they can do electrical as well as plumbing work. In this way a great deal of wiring is got through. Then comes the result of this system of working, which is perhaps better imagined than described.

What is most wanted, I believe, is to drive home the fact that electrical work is a separate branch to itself and not one which can be picked up by another tradesman and run as a by-show to his trade.

If it is found impossible to run a successful all-year-round business, which is most desirable, as a reliable and competent set of men can be kept better together, it seems to suggest itself to me that the combination of a motor and cycle repairing department would be the ideal one to make the work go round :—

1. Because the wireman should also be a good fitter.
2. The plant necessary would be of valuable assistance for any special electrical work.
3. The peaks of both departments should balance and be more likely to make an even yearly run than any other combination.
4. The incompetent wireman would be more likely to be weeded out.
5. It would be the means of elevating the status of the wireman who at present is regarded as one of a mixed family.

By this means I believe the wiring industry, more especially in the provinces, would be more qualified to turn out a higher standard of workmanship than under the present conditions of working, and also from a commercial point of view, a more economical state of affairs would result from an equalised working year.

I should like to hear the opinions of others in the trade as to the best means of securing a more reliable foothold for the electrical contractor.

Edward A. Hall.

Grimsby, *September 17th*, 1905.

An Overcrowded Profession.

The leader which recently appeared on the above subject had in it much worthy of thought, and there is no doubt that those who, after years of hard devotion to making themselves efficient both in practice and theory, fail to ever obtain ought but a position which brings but a bare living, have reason to conclude the profession is overcrowded. True it is, but to it should be added in the majority of cases "crowded with inefficients," and by this I would be understood to mean that the fault is not altogether with the workers, but with the training and surroundings they are inured to. In my humble opinion the technical training of engineering in all its phases would be much improved by the adoption of the method practised in the United States, where instruction professors are chosen who have to possess high qualifications for practical work in engineering in addition to the theoretical reasoning basis. Theory is good, practice is better, but the two combined make that scarce commodity "men"; from men who have all the college credentials possible, and yet fail to grasp the complexity of human nature as regards cultivating the tact required in business and the handling of a staff to produce in them that essential element *esprit de corps*, how can it be expected that they can command controlling positions and fill them with credit?

Further, owing to the predominant factors, influence and the "almighty" dollar, which at present is the key to more positions than those occupying them through this means would care to own openly, there are hundreds of zealous hard strugglers for existence in engineering work, who, however much knowledge they may possess, are never permitted to elevate themselves, being very often the backbone of the "inefficients" above them.

Another feature of an overcrowded profession is the prevalent idea that parents have, in particular, of the electrical profession—that it is a fine line to put their sons to, large salaries and ideal billets ; as an additional draw we have alluring prospectuses by various colleges or technical institutions, where, for a sum, say, of £200 or £300, young students may have so many years' training in the branch it is proposed to follow up, after which they will be passed out and practically put into a billet—a *very* essential item, this latter part, to the reputation of the college. All such institutions necessarily are kept well informed of all possible vacancies, hence outsiders who have no means for a course as above have difficulty in obtaining berths, and these "outsiders" form a large bulk of an "overcrowded profession." Again, among the student class it is difficult to drive home to the majority, the reasoning why they should cultivate so earnestly and steadfast, the essence of their tuition, enabling them by some years of hard work and study to prove creditable to their respective branches of work. Still more difficult is it to suggest a remedy for what appears an unsolvable problem ; add further the effects on our home industries of foreign importations in large consignments year by year, a matter, by the way, where the remedy lies in our own hands. From my humble point of view, may I be so bold as to suggest that we cease talking about what "England is, and was, and what we ought to do." Action is what is required. Take steps to improve, and allow efficiency to overcome the predominant partner, influence and the all-powerful dollar, giving every worker a fair field. Let the colleges have professors who possess the qualification before stated, giving less of the syllabus examination cram, and more of the solid item, but above all, ask your Education Committee to give them salaries that allow good men to throw some soul into the matter, also let there be more co-operation between the employers and employés, so cultivating, originality, initiative and good feeling. Truly may it be said in this matter, "Let there be light," probably when we awake from our present habit of giving matters consideration, and take action, the nation will develop more of the old type of Britisher men, who spoke their minds straight, worked hard and acted clean, instead of what has at present a tendency to become standard, a type who know how matters go, but lack the courage to express a true opinion or act on their own, for fear of adverse criticism from their own kind, being more artificial than natural. Finally, let it be made clear to young earnest students at the beginning of their careers the "known" difficulties in "getting on"; hence, they should be more persevering and

patient, and should by any chance the heads of electrical engineering departments feel dull, remind them of an excellent paper that is to be found in the *Journal of the Institution of Electrical Engineers*, Part III., Vol. XXXIII., entitled "Trans-Atlantic Engineering Schools and Engineering," by a well-known hard worker in the interests of students. It may be good for thought and help to prove that the whole matter is one in which it can be well said, "Wake up, England."

A. L. Stanton.

Southsea, *September* 14*th*, 1905.

Lorain System in Wolverhampton.

May I be allowed to amplify "your bold and almost unaided attack" on the above system referred to in your issue of September 1st.

When I "spoke airily of £20,000 profit" years ago I referred to the gross profit which would accrue on a five-minute service on 17 miles of route, *i.e.*, on 2,174,215 car-miles, but our mileage last year was 808,508, or much less than half. I also based my argument on receipts of 1s. a car-mile, whereas our receipts last year were under 11d. (but that is over 1d. more than the average of other towns).

This was taking the tramways as a going concern and from a limited company's point of view, and did not take into consideration paying off the whole of the capital in so many years by a sinking fund for the benefit of future generations.

You quote that "the report compares Wolverhampton working with 39 other undertakings" and the "one result" you are careful to draw attention to is the only result which compares unfavourably, *i.e.*, that the units per car-mile are ·24 higher, which, however, meant an extra income and a benefit to the electricity committee. In my opinion it is well worth the extra cost owing to the immunity from risk of falling wires.

You are quite right in saying that the Corporation fully understood that it would require 20 per cent. more electricity before they went in for the Lorain system. I won't go into your elaborate calculation about lighting, which is puerile. What I said was that some of the extra electricity used "was accounted for by better lighting on the cars," but you most carefully ignore the fact that the total operating costs, including the extra electricity, are ·2d. per car-mile less than the average of those towns. You might have quoted me further when I said that "the operating costs of Manchester were nearly 7d. per car-mile, as against 6½d. in Wolverhampton"—*i.e.*, 6·85d. and 6·55d. per car-mile.

If our operating costs were as great as the average of the 39 other towns it would have made a difference of £674, or, compared with Manchester, £1,011; or what loss "might have been made if the overhead system had been in use." This speaks volumes for the efficiency of our staff and the care and attention of our engineer, Mr. Shawfield.

One would imagine that you are very jealous of the success of the Lorain system in Wolverhampton, but any whip is good enough to beat a dog with.

You are absolutely wrong when you say that "passengers have to pay £960 more than the average passenger for the privilege of riding over Lorain Track." The extra ·03d. has nothing to do with the question. If we had a universal fare of 1d. for whatever distance a passenger rode, the average fare would be 1d., and if we had any ½d. fares the average would be less than 1d. As a fact, we sell a considerable number of 1½d. and 2d. fares (about 18 per cent. and 10 per cent. respectively), and consequently the average fare per passenger is over 1d.

You may just as well say that a passenger pays over 1s. for the privilege of riding to Birmingham by the North-Western Railway, because a certain amount are also booked from Wolverhampton to Coventry or London, and naturally the average tickets issued at Wolverhampton Station are over 1s. for each passenger.

You imply that £4,790 had to be spent on renewals last year (*i.e.*, in maintenance and repairs). As a fact we spent over £2,000 on renewals last year (under the head of maintenance and repairs), have also charged the renewals account with £4,790 for further renewals in the future, and have an accumulated balance in hand of £8,800 in our "renewals fund" (*i.e.*, for permanent way, &c.), which may not have to be drawn on for many years.

You are pleased to quote such portions of my remarks to the Council as you think fit. I told the Council that, "If we were a limited company we should have a gross profit of nearly 7 per cent. to deal with, and could pay a dividend of 5 per cent. easily, and carry £4,790 to reserve after spending over £2,000 on keeping the concern in going order."

I may remind you that "some time ago the Institute of Municipal Treasurers and Accountants and the Municipal Tramways Association appointed a joint committee to inquire into and report upon a standard form in which to present the accounts of municipal tramways undertakings. In January last copies of the form, which was unanimously agreed to by the Institute and the Association, were forwarded to the borough accountant and to the tramways manager, with a request that, in order to secure uniformity at the earliest possible date, the Corporation should adopt the form in respect of the financial year ending on March 31st, 1905."

We are one of the few towns who have not adopted the "standard form." Had we done so, we should have shown a gross profit of over £15,900, or, after paying interest and sinking fund, a net profit of £4,983.

I quoted Sunderland, who do keep their accounts on the "standard form." They have the same length of route as we have, but their income was £64,445, against £37,272. They made a net profit of £5,735, the whole of which they placed to "reserve fund," *i.e.*, they made no profit if they had kept the accounts as we have.

The cost of testing and repairing faults in the Lorain system is very much less than the apparatus involved in keeping the overhead wires in order. If a contact box gets out of order, it does not stop the traffic, as a car can skate over it, whereas a broken overhead wire causes a stoppage of the service of all the cars in the line of the accident.

It is very difficult to find out the actual figures of other systems, but I took the trouble to get them out for 1902, and the average of such towns as supplied details worked out at ·155 per car-mile, against our total costs of ·115 last year, or over 30 per cent. more.

Liverpool last year had to keep a staff of 41 men and six tower wagons on hand, and their costs for four years, amounted to nearly £25,000, and worked out at ·128 per car-mile.

On a small tramway system, such as Wolverhampton, it is absurd to expect a large contribution in aid of rates out of a total income of £37,000.

I repeat "I consider that our report is *very* satisfactory," and that I am glad we adopted the Lorain system (so, I believe, are the bulk of the inhabitants of this district).

I have no wish for the centre of our town to resemble a bird cage. Electricity is always a source of danger, but in my opinion (and I think that the bulk of the people in this district agree with me) the overhead system is an infinitely greater source of danger than the Lorain.

With reference to the negotiations which my committee have had with the outlying company, I have no wish to satisfy your "spirit of curiosity." You may rest assured, however, that it is perfectly satisfied with the agreement, the details of which were proposed by the company itself.

As your article has been copied and referred to in the Press, I have forwarded this letter to our local papers.

Charles T. Mander,
Chairman of Wolverhampton Corporation Tramways Committee.

Wolverhampton,
September 14*th*, 1905.

[If Mr. Mander could have known what satisfaction he would give us by writing the above, he would not have written it.

We pass over the apparent ruse to gain a week's advantage, which was obtained by posting the letter so that

it reached our offices last Friday morning, as we have bigger fish to fry. We have to thank the *Wolverhampton Express and Star* for their courtesy in holding over the publication of the copy of the letter which was sent to them on Thursday, until Friday, our publishing day. Naturally they thought that the Alderman was playing fair.

We ask our readers to con Mr. Mander's letter, for therein lies our justification. We ask them to believe that this letter is a true sample of the bulk. It justly represents the kind of matter which has given Wolverhampton its Lorain system.

Wolverhampton, mind you, not Daisy Bank or Prince's End, or one of the other villages near by.

The man who wrote this effusion has talked over a majority to try and to adopt a system about which neither he nor anyone else knew anything that was favourable to its commercial success. The thought makes us sad, for it involves so many intelligencies.

Mr. Mander thinks it no shame to own that he misled his Committee, the Council and the town by referring to £20,000 estimated profit when he meant gross profit on 70 per cent. more route mileage than is constructed at this day, or could be constructed except by a reckless enthusiast; and who but the same enthusiast could conceive that Wolverhampton could support an average five-minutes' service over its complete system?

Then, again, although the present receipts of 11d. per car-mile are 1d. over the average of other towns, the town was told that 1s. per car-mile was to be expected, or 2d. per car-mile over the average, and it is well to remember that this glowing figure was forged from the financial experiences of a steam and horse tramway which could not pay its way. That extra 1d., to which Mr. Mander draws our attention, would give him £9,000 (2,170,000 miles × 1d.) towards a *nel* profit of £20,000.

Are we to take it that chairmen of Tramway Committees, as a usual thing, press the spending of £200,000 of their ratepayers' money on off-hand estimates such as these to which Mr. Mander lightly owns? But there is worse to come.

We know the general ruling of local authorities with regard to depreciation, but we have never before seen in serious print (presumably the letter *is* serious) the suggestion that money bought in the open market by an English municipality should be liable to the risks which used to attach to loans made to South American Republics. That is the only way in which we can interpret the statement that the "airy" profit is bolstered by another £8,000 or £9,000 which ought to have gone to sinking fund. Mr. Mander has had so much practice in talking "municipal" finance to his Committee, that he forgets when he is writing to people who have been in the heart of electric tramways ever since the first was promoted, otherwise he would have pulled himself up before talking as he did about repudiating loans.

We drew attention in the article which has at last drawn Mr. Mander to the 194,000 units which were thrown away in Lorain equipment last year, but it appears that the more wasteful a tramway is, the more it benefits the town in which it is working, so long as the town also pays for the generation of electricity. If Mr. Mander owned a colliery and an ironworks, how much extra profit does he think he would make on the combination if he put down the most wasteful engines to drive his rolls, in order that more coal might be drawn to feed the boilers? Practically, the extravagance of one department is excused by saying that another is enabled to show better results thereby!

Mr. Mander proceeds to explain that he attributed some, not all, of the extra electricity to the better lighting of the cars. It is really quite a minor point, to what he attributed it, but the report of his speech reads "the extra cost in units was accounted for, &c. . . ."

We concede that we did "carefully ignore" the statement about the total costs being ·2d. less than the average, but we said that we were without means to criticise certain figures which made up those costs, and in the light of Alderman Mander's exposition of the principles which seem to govern the finances of a shaky department, we hold that our negative attitude is justified.

We endorse most cordially the tribute to Mr. Shawfield's efficiency, and we congratulate Wolverhampton on its escape from the even worse fate which would have overtaken it if the engineer had been one whit less enthusiastic and careful. We praise Mr. Shawfield, but do not envy him.

We confess, at once, that the "reasoning" is beyond us, which proves us "absolutely wrong" when we say that an increase of ·03d. per passenger over the average fare obtaining in 39 other undertakings has cost Wolverhampton passengers £960 more than the average passenger over the lines of those undertakings.

In the words of the King-jurist in the famous trial of the Knave of Hearts, "If there's no meaning in it, that saves a world of trouble, you know, as we needn't try to find out."

With regard to renewals, we implied nothing more than we said, and that was to refer to an item from the balance-sheet—"contribution to renewals fund, £4,790."

Surely Mr. Mander did not expect us to quote the whole of his remarks to the Council. What is the good of talking about the fine time a company might have if it owned the Wolverhampton Tramways? We have to deal with facts as they are, and they are incomplete enough. The balance-sheet shows £193 profit, when there still remains £4,688 deficit to be written off the horse tramways.

Does Mr. Mander propose to deal with this debt as he would like to deal with loans on capital account?

Either the Wolverhampton tramways have earned a profit, or they have not. The form in which the accounts are kept has nothing to do with the present point. The borough treasurer declares that £193 represents the profit, and if no more than £193 can be handed over to the rates, or carried to next account, we do not see why the people of Wolverhampton should be pleased to hear that, if the standard form had been adopted, the result would have *looked* better.

As to the statement that the average cost of maintaining the overhead work in "such towns as supplied details," was ·155d. per car-mile in 1902, we can only say that such figures are utterly abnormal, and an average taken over the English systems will not exceed ·100d. A definite statement is made with regard to Liverpool only. Wolverhampton tramways cover 10 miles, Liverpool 100. How many testing cars and testers would be wanted to watch the contact studs on 100 route miles of Lorain track? Would they cost less than one tower wagon and crew per 17 miles, as in Liverpool? The cost per car-mile of maintaining the overhead work in Liverpool during the last four years was as follows:—

1904.	1903.	1902.	1901.
·094	·095	·127	·199

The costs for 1901-2 were abnormally high, and we believe that they were due to insufficient inspection and defective material, but the figures for the last two years are indicative of a more normal state of affairs. We consider that the present cost of ·115 for the Lorain system cannot be reduced with safety to the public, and it is not by reason of insufficient inspection that it is so much above the true average of overhead systems, for that is most elaborately and constantly performed.

With Mr. Mander's statements of personal opinion we need not concern ourselves; our readers can judge how much they are worth; but we have serious doubts as to his authority to speak on behalf of "the bulk of the inhabitants of the district." What they think is well shown by the local Press.—Eds. E.R.]

Earth Detecting Instrument.

The problem propounded by "Mining Engineer" in your issue of September 15th—namely, to determine "what allowance ought to be made for the capacity current, in order to have indicated daily the leakage current"—is a somewhat complicated one.

Taking the case of main B, figures for which are given in "Mining Engineer's" letter, the capacity current flowing to earth through the instrument would work out at something like 5·9 milliamperes, corresponding to a capacity of, say, $\frac{1}{30}$th m.f. This capacity current, taken in conjunction with a leakage current of about ·4 of a milliampere, is, of course, formidable, but it must not be forgotten that in the

case of main B the insulation of each core amounts to nearly a megohm.

Assuming, in the absence of precise information, that the actual load of the station (that is, 225 KW.) is divided between the two mains A and B in proportion to the largest sectional area of each, the current carried by B would amount to, say, 110 amperes, and consequently the maximum allowable leakage current would be 110 milliamperes from each main, compared with which the capacity current of 5·9 milliamperes would be quite negligible, particularly when it is remembered that the two currents are in quadrature.

As a matter of fact, however, as the insulation resistance of the mains falls, less and less of the capacity current will flow through the instrument, with the result that its influence on the reading will be even smaller than that just assumed, and may well be neglected.

From a knowledge of the capacity (obtained either by a direct measurement, or from data such as those given in "Mining Engineer's" letter) it is, of course, always possible to draw out a diagram from which can be obtained the true leakage current "within the meaning of the Act." This, however, is a somewhat laborious process, and assumptions have to be made which may or may not be allowable in any particular case.

The best plan is probably to regard the instrument as an indicator (as recommended by the Home Office rules), and to interpret the readings from time to time, should the deflections increase to any extent, by means of a direct measurement of the insulation, as has been done by "Mining Engineer." If this is done the readings really become quantitative, which can never be the case so long as lamps or devices of that sort are used.

In the case of direct-current systems, it may be well to remark, the problem is a comparatively simple one, owing partly to the fact of there being only two mains to be considered, but more particularly owing to the capacity of the cable being without effect on the results. In this case, the instrument readings can be at once interpreted by means of a direct reading table, and the leakage current, as well as the insulation of each main, read off.

It will be observed that I have throughout dealt with main B only, and this is owing to the fact that in the readings given for main A, some mistake must, I think, have crept in. A deflection of 33 milliamperes on each phase does not seem to me possible on an insulated system, as it would indicate that when the instrument was connected between any of the mains and the earth, the potential difference between that main and earth was unaltered thereby, which is clearly impossible in view of the fact that the insulation of each main is more than 20 times that of the instrument. The only explanation I can suggest is that in some way or other the neutral point of the system (if it has one) must have become earthed, so that the system is not in reality an insulated one. In that case a reading of some 30 milliamperes might well be expected. The additional current cannot well be due to capacity in this instance, owing to the fact that the capacities are evidently balanced, so that they will not enter into the problem at all.

I notice with envy the extreme accuracy with which the insulation resistance has apparently been measured (to more than one part in 500,000). Probably, however, this is merely because the results have been worked out by means of logarithms.

Kenelm Edgcumbe.

Westminster, *September 19th*, 1905.

Telephone Amenities.

I have recently received two peremptory requests from the National Telephone Co. to pay them a deposit of £1 in respect of call fees in connection with my telephone subscription. At the time of their first application I had used 225 calls out of my 360. At the time of their second request I had still a balance of 100 calls in my favour, and yet their notice ends thus: "Unless payment of the amount is made forthwith the company regrets that it will have no option but to decline to put your calls through." According to my present rate of making calls it will be another three months before the company is entitled to ask for a further prepayment deposit.

If they adopt the same means with all their subscribers and receive a deposit many months in advance of the time it becomes legally due, it must be very much to their advantage.

It would be of interest, I think, to many subscribers if you could state what the legal position is under such circumstances as those recorded above; it appears to me to be little short of attempted blackmail.

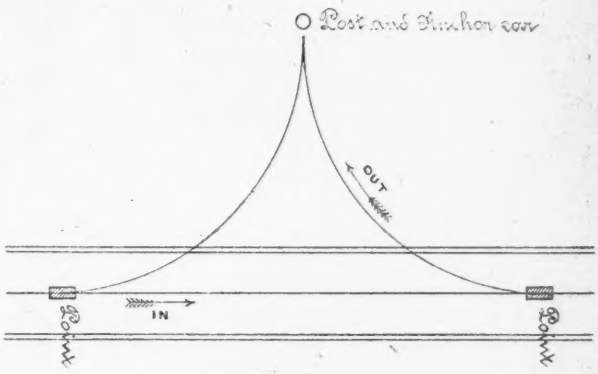
W. P. Adams.

Westminster, *September 19th*, 1905.

Trolley Reverser from India.

Folks at home are apt to imagine that in the land of tigers and other wild things, engineering is rather in keeping with the tigers, &c. As I read my REVIEW, which I receive only fifteen days old, I hasten to dispel the tiger engineering idea.

I was much interested in your description of Ward's patent trolley reverser, described in the REVIEW on August 11th.



Some two months ago I began to work on a scheme to automatically reverse the trolley poles at our new car-shed, which contains six roads. Enclosed are two photographs of a small model of the scheme, also a plan of the overhead equipment for one road, which I think you will agree needs no explanation.

A protection has been taken out for the arrangement in India.

J. F. Jones.

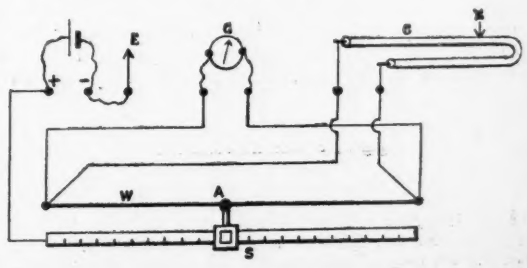
Madras, *August 31st*, 1905.

[We congratulate our correspondent on his ingenuity, and regret that the photographs were not suitable for reproduction.—EDS. E.R.]

Wire Bridge for Cable Testing.

In your issue of August 25th, 1905, I note that in an article written by Mr. G. C. Knight there is described a "fault" localising form of wire bridge for cable testing. I beg to state that, curiously enough, this identical form of instrument was constructed and used by myself, and others, in Bermuda in the year 1894, and I have used it, and others at other stations, fairly continuously ever since.

Practically, I have found it a most excellent means of localising "earths" in lengths of cable.



The scale in my instrument was divided into tenths and hundredths. Whatever the length of cable tested was represented on this sale. Zero was in the centre of the scale.

I append a rough electrical diagram of connections.

E

The use of an *accurate* resistance coil by a suitable modification converts it into an excellent "Wheatstone's Bridge."

J. Palmer,
Quartermaster-Sergeant (Mechanic & Electrician), Royal Engineers.

Cardiff, *September 17th*, 1905.

Finding Fault.

The articles and letters on fault finding are very interesting (mostly fiction) and amusing. It appears that by the time one has unravelled a man's pet methods and made allowances for all the complaints of other men on them, appearing in the following issues, the only faults that can be found are likely to be those that the fault finders find with each other.

D.

Municipal Trading.

I have before me, as I write, a pamphlet issued by the Lowestoft Corporation Electricity Department to their consumers extolling a certain make of incandescent lamp, and stating that they are prepared to supply the same at *cost to them, purchasing large quantities.*

Now, Sir, we ratepayers have heard a great deal lately anent municipal trading, and doubtless, where it reduces our rates, it is a very fine thing; but where, as in the present case, that same trading reduces our business without affecting our rates, I think it is only right to protest against a most unfair competition.

This pamphlet goes on to state that, "These lamps, by consuming less current, reduce the consumer's bills."

I am not directly connected with any branch of the electrical industry, except through my meter, and so may be in error, but I have always understood, in common with the other "individual in the thoroughfare," that the greater the demand the lower the rating.

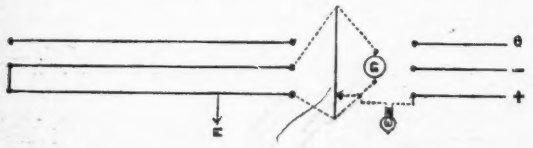
I should really like to hear the views of some of your technical readers on this subject, as if this practice is likely to spread I may look for active competition in the prices of half-shoulders and lamb chops.

E. J. Cunningham.

Catford, *September 19th*, 1905.

Localisation of Cable Faults.

An error unfortunately occurred in our reproduction of fig. 1 of Mr. Henry Joseph's article under the above heading



last week. We reproduce the figure showing the correct connection, which was doubtless easily guessed by readers of the article.

We regret that, owing to the pressure on our "Correspondence" columns, we have been obliged to hold over several letters which came to hand on Wednesday morning.

Mill Gearing.—The "Unbreakable" Pulley and Mill Gearing Co., Ltd., of Manchester, have secured the contract for the complete equipment of the new mill of the Radcliffe Loom and Power Co., Ltd., Radcliffe, Manchester, with their "Unbreakable" W. I. pulleys, swivel bearings adapted for "Diamond" lubrication, couplings, and bright turned Siemens-Martin steel shafting, for the production of which they have a large and up-to-date plant.

BUSINESS NOTES.

Electrical Enterprise in Mexico.—It is reported that the Mexican Electric Light Co. has been formed as a Canadian company at Montreal with a share capital of £240,000 and an obligation issue of £240,000. The company owns the concession for the exploitation of the waterfalls of Necaxa, and takes over the property of the Compagnia Explotadora de las Guerzas Hydro-Electricas, of San Ildefonso, and of the Gas and Electric Light Co. Another scheme relates to negotiations which are said to be proceeding both in Berlin and London with a view to the establishment of a large electrical undertaking in Mexico, both for lighting and power purposes. It is reported that the constitution of this new company will take place in October.

Sunbeam Lamp Bulbs.—We recently referred to the fact that glow lamp bulbs are not usually made by British lamp manufacturers, the reason being the great difference in cost between British and foreign bulbs. Had not the glass manufacturing industry been hopelessly crippled years ago by the trade union, we might to-day have been exporting bulbs, instead of importing them. However, it appears that the trade is not quite extinct in the North, its ancient centre, for the Sunbeam Lamp Co., Ltd., manufacture both the glass and the bulbs themselves at their own glass works in Gateshead. The Sunbeam lamp is thus entirely English-made.

"Hygienea" Telephones.—The accompanying figures show a novelty which is being introduced by the Sterling Telephone and Electric Co. (late Berliner). Repeated attempts have been made to do away with the foul odour emanating from the mouthpiece of a transmitter that is frequently used, with little success; the Sterling Co. have gone one better, and done away with

Fig. 1.

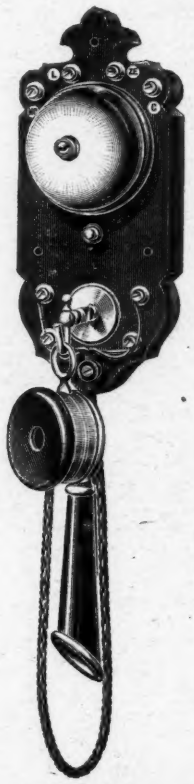


Fig. 2.

the mouthpiece. It might be supposed that this would hinder the efficiency of speech reproduction, but this is not the case; on the contrary, we can vouch for the fact that excellent results can be obtained with these hand-combinations, while their appearance and convenience leave nothing to be desired.

Fig. 1 shows a domestic set, with automatic hook and push button for fitting on existing electric bell circuits, calling one way or both, as specified; fig. 2 shows a more pretentious instrument, containing an induction coil and bell, and capable of speaking over considerable distances. A neat table pattern is also made. Pamphlet No. 101 gives full particulars of this new line.

Liquidation.—In the Vacation Court on Wednesday, before Mr. Justice Bray, Mr. Bramwell Davies, K.C., asked for a compulsory winding-up order in the matter of the Leslie Walker Instantaneous Fire Detector and Fire Indicator Co., Ltd., on the petition of Mr. C. J. G. Stenning. Counsel for the company asked for a further adjournment on the ground that negotiations were in progress for the sale of the company's patents, and there being no affidavit setting out this fact, his Lordship made the usual compulsory winding-up order.

Pressed Steel Valve Bodies for Superheated and High-Pressure Steam.—Cast-iron has long been condemned as a material for valve bodies, except for low-pressure steam. It is weak, brittle, and unreliable, and has caused many accidents. Cast steel is now much used in its stead, but it is liable to blow holes, and it is very apt to be warped out of shape in the casting. It is also not an easy material to machine. With the high pressures now in vogue, and the high temperatures of superheat employed, a really sound and reliable material is much required for valve bodies, and for this purpose there is at present nothing to equal mild steel. Acting on this belief, the Cruse Controllable Superheater Co. have brought out a new form of valve. The body is hydraulically pressed in two parts from stout mild steel plates, and these pressed halves are riveted together with a central diaphragm plate. This diaphragm forms the division between the inlet and outlet openings of the body, and it carries the valve seating of nickel steel. The valve and the spindle are also of nickel steel, gun-metal not being a reliable alloy at the temperature of superheated steam. The openings for the spindle are flanged to take a steel closing plate which carries the gland and pillars, and the whole of the construction is specially devised for the arduous duty of being safe and tight under the most stringent modern conditions of pressure and temperature.

Milling Machines.—We have received from Messrs. Alfred Herbert, Ltd., a catalogue of their milling machines, which is more than a mere catalogue, because in it are illustrated various special milling operations which help the user of machines in selecting methods for doing work. Then there is a form given for the keeping of records of work with a view to keeping performance up to the mark, as well as to serve as a guide for making estimates and setting prices. Instructions are given for the installation and general adjustment of machines so as to ensure best working results, each main detail being taken in turn, and there are practical notes and suggestions interspersed. Short, but none the less of value, is the page on how to prepare work for milling. Thus, painting and japanning are sometimes advantageously to be done before milling any surfaces. This may waste a little paint, but it will often save much time and labour. The importance of pickling and how to carry it out are emphasised, and, finally, there is a section descriptive of milling cutters, and some excellent remarks on pitch and its effects. Illustrations, tables and prices of the usual forms of cutters are added, with arbors, callets, chucks, and a table of cutting speeds. The machines for which all these tools are intended are fully illustrated and described in the earlier part of the catalogue.

Electricity in Sweden.—In a publication recently issued by authority of the Swedish Government on the trade, industry, &c., of Sweden, are several interesting notes regarding electrical development in that country. The electrical industry there has undergone an immense development during recent years. Concerning the resources of water-power, an approximate calculation was recently made by Prof. Arrhenius, according to which the total supply was estimated at 4,000,000 h.p., and the reflection was made "that probably 10 to 20 per cent. of the motor power at present requisite for the industries and rail traffic of the whole world could be furnished from Swedish waterfalls." Even taking into consideration that the greater proportion of this abundance of power is located in parts of the country where it cannot at present be profitably utilised, there is sufficient supply of power for the needs of the country itself for a long time to come in waterfalls suitably located in the southern and central parts of the country. A certain number of these are already put to use, chiefly for the mining and iron industries.

The first transmission of electric power of great significance was carried out in 1891-2 from Avesta, on the River Dalelfven, to the Norberg mining district. Subsequently there have arisen in quick succession a number of such transmissions of considerable dimensions. At several large iron works, such as Sandviken, Fagersta, Hofors, &c., the rolling mills are worked by three-phase electric motors. The first rolling mill motors were erected in 1894-5 at Hofors (200 h.p.); the largest motor for this purpose is to be found at Fagersta (600 h.p.). They are generally of the "Tandem" system, elaborated by the General Swedish Electric Co., Ltd., at Vesteras. Rolling mills with continuous current are set up at Nykroppa, constructed by the Electrical Co., Ltd., "Magnet," at Ludvika. At several places enriching works for the utilisation of poor ores have been established, where the enriching is carried out by means of magnetic ore separators of Swedish construction. The Sandviken works possess one of the largest power distributing establishments where 2,000 h.p. are distributed on some 80 motors. Where water-power is not available, the distribution is made from a steam-driven station, as at the Aktiebolaget Separator in Stockholm, the Falun Carriage Factory, the Hoganas Coal Mines, a number of sawmills in Norrland, &c.

For electro-chemical industries large quantities of power are consumed, as at the Mansbo chlorate factories, 3,750 h.p.; the Alby carbide factory, 2,000 h.p.; and at a Trollhattan factory, 3,000 h.p. At the Gysinge works a great quantity of the power is used for electrical steel smelting according to the Kjellin method. Such steel smelting is also carried on at Brattfors on the Héroult method.

Electric railways are principally in use only for small goods traffic; these lines use a continuous current at 500 to 600 volts. For passenger traffic there is a narrow gauge railway from Stockholm to Djursholm. The question of running the State railways as well as the larger private railways by electric power has received earnest consideration. Electric tramways exist in Stockholm, Gothenburg and Helsingborg, and are in preparation in certain other towns.

Among the 93 towns in Sweden, 53 had at the time of writing introduced electric light, which is furnished either from works conducted by the respective communities or concessioned companies, and several others were intending to erect central electric systems. The largest central station for electric lighting is in the capital. In 1890-1 a steam plant of 2,000 h.p. was built, furnishing the current on a three-wire system with a tension of 2 × 110 volts. The machines are assisted by large batteries. Owing to the large increase of consumption these works became insufficient, and in 1903 a new larger steam station was built outside the town, planned for 16,000 h.p., which, by a three-phase alternating current at 6,000 volts, furnishes the electricity to four sub-stations in the town. From these a continuous current of 2 × 220-volt tension by means of asynchronous motor-generators, in connection with storage batteries, is distributed. Several towns are lighted by power derived from waterfalls, and in many cases the old steam stations have been enlarged and supplemented by transmission of water-power.

The electro-technical industry in Sweden has made great progress during the last decade. At first electrical machines, as well as other electrical articles were imported, the principal furnishers being the large German firms. Gradually, however, the home machine industry has developed to such a degree, that at present it is able successfully to compete with foreign countries. The largest Swedish factory is the Allmänna Svenska Elektriska Aktiebolaget, at Vesteras. Luth and Rosens Elektriska Aktiebolag, in Stockholm, commenced the manufacture of electrical machines in 1897. Of late, two energetic companies have sprung up, the Joint Stock Co. Magnet, Ludvika (1900), and Arbra Mekaniska Verkstad (1903). Some smaller factories (chiefly for the manufacture of small motors) have been in existence, but most of them have ceased their activity. Other electrical material than machines is still for the greater part being imported. Arc lamps are partly manufactured in the country, as are also electric wires and cables and porcelain insulators.

The great importance of electric power transmission and distribution for the industrial development of the country, especially with regard to the utilisation of accessible natural forces, has, during later years, necessarily attracted the attention of the law-giving authorities, who have taken measures for promoting and controlling the establishment and subsistence of electric concerns. These measures place Sweden in a very advanced position as regards legislation in this respect.

Improved Chain-Grate Stoker.—The ordinary chain-grate stoker is a collection of short cast-iron bars carried by a series of transverse pins or rods like a link belt. Where the chain grate thus formed, bends in passing over the end rollers, the links open out, and the chain becomes very open and lets in an excess of air. This open end, if not covered by the damping plate, admits ash and clinker, and a hard lump may prevent the grate closing when it reaches the straight position again, and thus place a great stress on the link pins or rods. In the Miller-Bennett chain grate, which has been acquired by Messrs. Bennis & Co., each short link is cut away on one side, and has a projecting boss on the other side, and when erected the links fit closely together and move round the terminal roller without causing any projection or opening in the chain. There are no through rods, but each line of links is complete in itself and independent of the other. No openings for clinker to enter are left, and the chain as a whole is relieved of much stress. To this improved grate a water-cooled dumping bar is provided, and the rear end roller is solid faced so as to minimise the influx of air through the grate where bare of fuel. The chain grate is ideal in respect of its self-cleansing property, but all chain grates burn their fires thin at the rear end and admit an excess of air. The improved grate gets over a part of this trouble, and is altogether a great improvement upon the old form of chain grate. This class of grate is, of course, applicable to mechanical stokers of the coking variety.

A Cape Town Lawsuit.—We have received particulars, from a South African correspondent, of an action which has recently occupied the Courts at Cape Town (Hon. Mr. Justice Maasdorp). The case was that of Herron *v.* Torque Electrical Engineering Co., and Others, and it occupied the Court a number of days, after which judgement was reserved, it being subsequently delivered on August 14th. The action was brought by George Frederick Herron, an engineer, at present of Cape Town, against Edmund William McLachlan Thomas, in his capacity as trustee in the insolvent estate; the British General Electrical Co., the Telegraph Manufacturing Co. (Colonial), Ltd., Stewards & Lloyds (S.A.), Ltd., and Siemens, Ltd., all of Cape Town, to have an order of sequestration superseded and discharged against the plaintiff, for a preferent claim for £1,000 in respect of two dynamos pledged to the plaintiff, and £2,500 damages.

The declaration set out that on a petition the Torque Electrical Co. was provisionally sequestrated, and among five partners the name of the plaintiff was included. On the return of the summons in connection with the making of the order final, the plaintiff appeared, and filed a short affidavit denying that he was a partner in the Torque Co. The Court pronounced final sequestration against all the partners, but gave leave to the plaintiff to bring an action to prove he was not a partner. The last four defendants maliciously instituted proceedings in insolvency against the plaintiff as a member of the Torque Co., and caused the plaintiff's name to be included in the order of sequestration. The plaintiff had never been a partner of the Torque Co., and never held himself out as such, but on the contrary, he frequentiy represented to the last four defendants that he was not such a partner, and by reason of his name appearing he had suffered damages in £2,500. On November 10th, 1904, the plaintiff agreed with the Torque Co. to endorse a

bill for the sum of £1,000, the said company undertaking to deliver three dynamos to the plaintiff as security. The plaintiff had ultimately to repay the amount to the bank. After the sequestration, the first-named defendant took possession of the dynamos, and the plaintiff claimed to rank as a preferent creditor to the amount of £1,000, for an order declaring the plaintiff not a partner, and superseding the final order of sequestration against him as against the first defendant, and as against the last four defendants judgement for the sum of £2,500, with costs.

The defendants, in their plea, admitted the order of sequestration, but submitted that the claim for damages was bad in law and disclosed no ground for action. The proceedings were not maliciously taken, but were *bona fide*, and taken on reasonable cause. The Torque Co. commenced business in Cape Town in September, 1904. The business was conducted by the plaintiff and Neale, both of whom gave orders to the Torque Co. for goods to be supplied, and in general the plaintiff carried on the business, and led the defendants to believe that he was a partner in the Torque Co., which had a contract to supply light to the Cape Town Exhibition. The defendants did not admit that the plaintiff paid the company the said money, or that the company delivered the dynamos to the plaintiff. The defendants further alleged that the pledge was made when the company's liabilities exceeded its assets, and at a time when insolvency was contemplated, and was, therefore, undue preference, under the Insolvency Ordinance. In reconvention they claimed that the pledge should be set aside. The replication denied that the plaintiff carried on or conducted the business, or that he led the defendants to believe he was a partner in the company. The Nealeron Co. was formed to assist the Torque Co. with the contract.

We have not space to report the hearing in detail. Those who wish to follow the matter more fully, will find an account of the proceedings in the *Cape Times* for July 6th, 7th and 8th, and the judgement in the issue of that paper for August 15th. At the conclusion of his judgement, Mr. Justice Maasdorp said:—"Although I hold that Herron was no partner in Torque, and do not go into the question of estoppel, still circumstances did exist which led to the reasonable belief in the partner of the four last-mentioned defendants that Herron's interest in the business was such that he might in law be regarded as a partner, and I am of opinion that they did not act maliciously in the legal proceedings taken by them. The plaintiff sets up a claim against the insolvent estate of the Torque Co. for £1,000, and also claims a right of pledge for this debt in respect of certain machinery, But it seems to me he has mistaken his remedy. The machinery for proving debts and setting up preferent claims is provided by the Insolvent Ordinance, and the plaintiff must proceed in the ordinary way. But I am quite prepared to express the opinion that the pledge was never validly constituted. The machinery remained in the possession, and under the control of Neale, and at the time of the alleged delivery was actually still in the course of erection for use by Neale. The Court will order that the final order of adjudication be varied by striking out the name of Herron as partner in the Torque Co. Defendants to pay the costs."

Charges of Fraud.—At the Worship Street Police Court last week, a Frenchman was brought up on remand on a series of charges, including obtaining a voltmeter from the Walsall Electrical Supply Co., 116, City Road, E.C. According to the evidence for the prosecution, the prisoner, on August 11th, called at the company's place and asked the price of the instrument, saying that he was from the firm of Collins & Collins, 33-4, Chancery Lane, with a view to placing orders should the price list prove satisfactory. He was supplied with lists, and went away ostensibly to submit them to his "firm"; but he returned an hour or so later and asked for a meter "on approbation." One was handed to him, and nothing more was seen or heard of him until after his arrest, but meanwhile the meter had been returned to the company's place by a lady. Evidence was given by the caretaker of the Chancery Lane building indicated, but neither the prisoner nor the firm mentioned by him, was known there. Then came the police evidence and the accused's pretty free knowledge of English. Detective Ratliff deposed that about noon on the 5th inst. he was in company with Detective Mold in Central Street, E.C., when he saw the prisoner. Believing him to be a person who was "wanted" on another charge, he followed him to Golden Lane, where he entered the premises of Messrs. Mackie and Co., dynamo makers. He called him out and told him he answered the description of a man who, by means of a trick, had stolen a voltmeter. He was told he would be taken to the police station, whereupon he admitted he had the meter, and added, "If they won't charge me they can have their meter back We have not done fraud. If they will not charge me I will get the meter back in 24 hours, and pay them for their trouble. If people are so silly as to part with their things like that, I can't help it. Just now the meter is in Paris." The prisoner, who insisted on a French interpreter being employed, was committed for trial. He had been lodging off Euston Road.

William Leslie and Frances Cheeseman, who have been wanted for some weeks on the charge of being concerned with Webber and Rosenberg, of Putney, in the alleged electrical frauds case in London, already reported, were arrested at Aberystwith on Saturday last. It is stated that the police found £6,000 in sovereigns and notes, and other property amounting altogether to £7,950 among their belongings.

Forbes v. Neal.—In the Vacation Court on Wednesday before Mr. Justice Bray, the case of Forbes *v.* Neal came on for hearing, on a motion for judgement in default of defence. The defendant, John Edward Neal, was stated to be an electrical engineer carrying on business in various parts of the world, with a branch in England. The plaintiff, William Samuel Forbes, entered into partnership with the defendant and paid a sum of £250 as premium. He now alleged that he had been induced to enter into the partnership by misrepresentations as to the position of the English branch, and he claimed rescission of the partnership agreement and a return of the premium. His Lordship made the order asked for.

Consular Notes.—Australia.—In a recent exhaustive report on trade conditions in Australia, the German Commercial Attaché at Sydney observes that the Australian Commonwealth has, relatively speaking, one of the finest tramway systems in the world; and of all the States, New South Wales, with its chief town Sydney, has, perhaps, the best service. Consequently the tramways create a good demand for electrical and other material. Owing to the extended nature of Australian towns, a very good field exists for tramway undertakings, in which the several Governments are taking great interest.

Bolivia.—In a report on Bolivia, recently published by the Bureau of American Republics, Washington, it is stated that Sucre, La Paz, Cochabamba, and Potosi afford positive advantages for the establishment of electric light plants operated by hydraulic power. The first of these cities can utilise the waters of the Cachimayo River, which is but a short distance from the town; the city of La Paz can use the Choqueyapu River, which flows through its centre; the city of Cochabamba can utilise the waters of the Rocha River, and especially those of the Colomi River, which, at a distance of 30 kilometres from the city, has a fall of more than 100 metres; and the city of Potosi can use the waters of the neighbouring lakes. The rights of the companies which may establish this class of industry are duly protected by law. In 1888 an electric light plant was established in La Paz, and the power house was located in the upper part of the city in order to use the water of the river. The contract now in force between the municipal council and this company contains the following clauses:—The company agrees to light the city, using for this purpose 425 incandescent lights of 16-c.p. each and eight arc lamps of 3,000-c.p. each. On moonlight nights the company furnishes no light to the city, and on other nights only until 1 o'clock in the morning. The municipal council pays an annual subsidy to the company of 26,000 bolivianos (about £2,000), payable monthly in advance. The duration of the present contract is eight years, of which over five have expired. By decree of May 8th, 1858, importers of machinery for any manufacture or industry unknown before in the Republic are guaranteed an exclusive privilege for 10 years. This term may be extended by legislative enactment. Municipal governments pay subventions only for public service, leaving the companies free to contract with private individuals in such terms as they may deem most convenient. In addition to the points already mentioned, where water could be utilised as power, responsible companies or individuals desiring to establish new industries in the country have the right to select any other place for the erection of the plant, with the privilege of extending their operations to other parts of the country. A concession would be granted permitting the use of the national waters, provided that, after generating power from the same, the waste waters are returned to the streams from which they were originally taken. In case of a joint stock company, organised for the purposes mentioned, it would have to pay to the State 2 per cent. per annum of its net profits. At the expiration of the concession, the Government may grant other companies desiring to engage in the same line of business concessions equal to the original, and, all things being equal, no preference is given to any particular company.

Spain.—The Austro-Hungarian Consul at Seville in a recent report states that a manufactory for the production of electric lamps was started in that town on a great scale, but that it is now closed owing to dissensions which have arisen between the directorate and the shareholders of the company.

Turkey.—The Austro-Hungarian Consul at Salonica reporting on the textile trade and industry of Turkey, observes that a new yarn spinning mill worked by hydraulic plant of 250 h.p. was last year put into full working at Karaferia.

Dinner.—In connection with the cricket match which was to have been played on Saturday, the 9th inst., between Veritys' Birmingham Cricket Club *v.* Veritys' London Cricket Club, and which unfortunately had to be postponed owing to the inclemency of the weather, the two teams and other members of the staff, both from London and Birmingham, dined together at the Café Monico at the invitation of the company, under the chairmanship of their London director, Mr. C. S. Northcote. A most enjoyable smoking concert was subsequently held, the visitors returning to Birmingham by special saloon, shortly after midnight.

Lamb Bros. v. Garnett & Rene.—In the Vacation Court on Wednesday, before Mr. Justice Bray, the case of Lamb Bros. *v.* Garnett & Rene was mentioned in a motion for an injunction to restrain infringement of patents relating to sparking plugs. It was now stated that the defendants had admitted the infringement and were prepared to submit to a perpetual injunction and to pay an agreed sum as costs.

Colliery Development.—The Consett Iron Co., Ltd., are about to equip their Chopwell and Garesfield Collieries with a complete electrical installation, which presents some novel features. The current will be generated at the Chopwell Colliery at a pressure of 625 volts three-phase. Part of it will be raised to a pressure of 3,000 volts and transmitted to the Garesfield Colliery, at which point it will be reduced again to the working pressure of 625

volts. This will be one of the first high tension installations carried out to the new Home Office Rules. The order for the work has been placed with Messrs. Bruce Peebles & Co., Ltd.

Messrs. Barber, Walker, of Nottingham, have placed a contract with Mr. P. J. Mitchell, of 52, Queen Victoria Street, E.C., for the generating plant required at their new Bentley Pit, near Doncaster. This contract consists of a complete central station, including two 500-kw. low pressure turbines with accumulators, for the use of exhaust steam on Prof. Rateau's patent system, together with the necessary three-phase alternators, exciters, motor-generators, switchboard, cables, condensing plant and cooling tower; also for two high-lift Rateau patent centrifugal pumps direct coupled to totally enclosed watertight 600-b.h.p. motors, water-jacketed, with vertical spindles for suspension in the shafts, each pump being capable of delivering 2,000 gallons of water per minute to a head of 600 ft.

Smoke Nuisance.—Quite a spirited correspondence has been taking place for some time past in the daily Press anent the smoke emitted from the chimneys at the Neasden power station. A marvellous flow of language and fertility of invective are exhibited by the writers, and the local authorities are being even more roughly handled than the railway company.

Cooling Towers.—Messrs. Richardsons, Westgarth & Co., Ltd., of Hartlepool, have secured an order through their Glasgow agents, Messrs. A. R. Brown, McFarlane & Co., Ltd., for three natural draught chimney-type cooling towers for a total capacity of 255,000 gallons per hour, to be erected in the new works of the Kosmoid Tube Co., Ltd., at Dumbarton. They are also supplying another tower to deal with 50,000 gallons per hour to the Scottish House-to-House Electricity Co., Coatbridge. These towers will be fitted with the makers' new patented machine-moulded splash bars.

Russia and the United States.—A communication from the Czar, abolishing discriminating duties on American imports, was received by President Roosevelt on September 10th. These differential duties were first imposed in 1901, and ranged from 20 to 30 per cent. extra on such articles as manufactures of iron and steel, machinery, sewing machines, meters, dynamos and locomotives. Commenting on the news, the *New York Times* says that the retaliatory duties had the effect of giving English and German manufacturers an uncontested market in Russia.

Safety Pliers Carrier.—A neat safety lock carrier for pliers and tools has been brought to our notice by the makers and inventors, Messrs. Castell & Gibb, of 247, St. John Street, E.C.; the device, which is being patented, is illustrated herewith. Fig. 1 shows it arranged for clipping on the waistband, while figs. 2 and 3

For fixing direct.

Fig. 1.

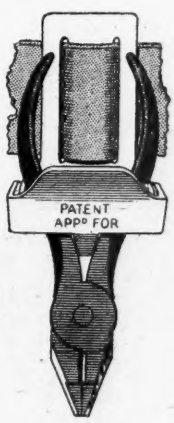
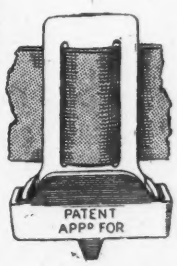


Fig. 2



For Belt

Fig. 3.

show it in connection with a belt. The pliers or other tools are held in a spring clip so that they cannot fall out, whilst they can readily be released from the clip whenever wanted for use. An electrical wireman who has lost his pliers is a helpless mortal, and this handy appliance should go far to prevent such a disaster.

Trade Announcements.—The name of the Berliner Telephone Manufacturing Co. has been changed to the Sterling Telephone and Electric Co. The proprietorship and management of the company remain unaltered. We understand that it is the intention to set up a factory in this country at an early date. The City address is 200, Upper Thames Street, E.C., as hitherto.

The Electrical Trades Engineering Co. have moved their office from York Place, Baker Street, W., to their head office and works, Crown Electrical Works, 2, Maygrove Road, Brondesbury, London. All communications should be addressed there.

Bankruptcy Proceedings.—Holmes & McCallum.—At the Blackburn Bankruptcy Court on September 13th, the examination of Alexander Holmes and Alexander McCallum, trading as Holmes & McCallum, electrical engineers, of the Crown Works, Darwen, was closed.

Robert Pries, Electrical Sundriesman, 75, City Road, E.C.—First meeting, September 25th; public examination, November 3rd—both at Carey Street.

Cricket.—Hammersmith *v.* Birmingham.—On Saturday last members of the cricket section of the General Electric Co.'s Athletic Club, from Witton Works, Birmingham, journeyed from Hammersmith to play the annual cricket match with the Robertson electric lampmakers. Although Birmingham brought with them an extra strong team, they finally suffered defeat by 18 runs, and had by force to take back the wooden spoon to Birmingham. The finish of the match was very exciting. The last six-wickets with Birmingham fell down for seven runs. After the game, both teams and their friends were invited to dinner at the Brook Green Hotel, where the chair was taken by the president of the Robertson Lampmakers' Club, Mr. C. Wilson. After the dinner a smoking concert was held.

Book Notices.—*Précis d'Hydraulique.—La Houille Blanche.* By R. Busquet. Paris: J. B. Baillière & Fils. 1905. Price 5 fr.—The possession of mountain summits crowned with accumulations of snow and ice has been made a precious heritage by the development of electrical transmission of power, and this inexhaustible store of energy has appropriately received the name of *houille blanche*—white fuel—in contradistinction to its rival, coal, the "black bread," as the author calls it, of industry. In order to utilise to the best advantage these natural resources, which France shares with her neighbours in the Alps and Pyrenees, a knowledge of the theory of hydraulics is indispensable, and in his book M. Busquet has endeavoured, with a considerable degree of success, to present his readers with the whole of the theory and calculations necessary for the construction of hydraulic works and machinery, but without recourse to advanced mathematical methods such as are generally involved. The work naturally abounds in rules and formulæ, but these are of a simple character, within the grasp of the average student or engineer. The theory of the flow of water in pipes and open conduits is given, with illustrations, and is followed by detailed treatment of water-wheels and turbines. There is, unfortunately, no index, but otherwise the work is worthy of commendation.

The Electro-magnet. By C. R. Underhill. Van Nostrand. Price 6s. 6d.—This is a small book of 155 pages in which the design of small electro-magnets, such as are used for telegraph work, &c., is treated in a thoroughly modern manner. Giving the formulæ for tractive force, the author shows how to determine the dimensions of an electro-magnet to exert a given attraction, and from the usual induction curves to calculate the ampere-turns required. From the ampere-turns the author shows how to ascertain the correct size of wire suitable for the voltage across the coil, and gives formulæ for the calculation of the temperature rise which will occur in working. A quantity of practical information is given on the best methods of winding, insulating, &c., and respecting pitfalls to be avoided. The book should be of value to those engaged in the design and construction of telegraphic or other apparatus in which small magnets are used.

Modern Windings of Continuous Current Dynamos. By Meynier and Nobiron. C. Beranger, Paris. Price 4 fr.—This is a pamphlet dealing with the methods of winding toothed drum armatures with formed coils. The first section gives diagrams of lap and wave windings for bipolar and multipolar machines, together with formulæ, of the same type as Arnold's, for the spacing of conductors, also the usual formulæ for resistance and E.M.F. In the second section a number of drawings are given of armature coil formers, with explanations of the methods of winding the coils on the former, removing them and assembling on the armature. The pamphlet is in French, and may be useful to those who wish to study armature windings and technical French simultaneously.

The Compound Engine. By W. J. Tennant. London: Percival Marshall & Co. 1905. Price 2s. 6d. net.—Authors' prefaces are not invariably a reliable indication of the contents of their book. Mr. Tennant has, however, in his preface set himself the answering in general terms of the following questions:—(1) What is the characteristic feature of a compound engine? (2) Why is the low-pressure cylinder larger than the high-pressure; and how much larger should it be? (3) What is the use of a receiver? (4) What is the full meaning of the familiar statement that "back-pressure in the high is forward-pressure in the low?" (5) How is "drop" determined? Readers of the Electrical Review do not fall within a category of mechanical tyros of this order. To those, however, who need to ask such questions, this book supplies simple and lucid answers. The remaining chapters deal with indicator diagrams, receiver proportions, condensers, air-pumps, steam jacketing and superheating, and treat these from a less elementary standpoint. Three appendices, one by Prof. Sir William Unwin (reprinted from *Engineering*) on "The Construction of Theoretical Indicator Diagrams," another by Mr. J. W. Tennant, which is a reprint of part of a paper on "Expansion Curves" (read before the Junior Institution of Engineers), and a third, consisting of dimensions of typical compound engines, complete the book.

From the Beginning. By Henry Loring.—This book deals with neither theology nor fiction, as its title might lead some to imagine. It is more interesting than many a novel, and than the majority of sermons, and to a multitude of men might teach something that has never come their way before, and is well worth the knowing. How many users of incandescent electric lamps have the very vaguest notion of the methods employed in their manufacture? Very few! but Mr. Loring has in this book attempted to take the hard facts associated with the production of Robertson lamps—a British industry, as of course we all well know—and weave them with an interesting touch into a romantic story which even those who know the facts already, might read without throwing the hours away. The old-fashioned in lamp design, and in generating station equipment, are illustrated together, for comparison with the quite up-to-date. The lapsing of the Edison patents in 1893 with

the opportunity that that event gave the General Electric Co. of setting up the Robertson lamp factory, the works at that date and at this, the staff and directors, the innumerable operations observed in the course of a tour through the many departments, the fire brigade—that pride of the directors and every man and woman in their employ—all these and many other like things are told attractively in this book. Then comes a list of the advantages of electric lighting over other forms of illumination—advantages which the general public ought to know in these braggart days of gas; half-a-dozen pages of midget photographs of central station engineers "who produce the current for Robertson lamps"; some necessary don'ts for consumers—all of these things abundantly illustrated with personal photographs and views of departments, brought within the compass of 113 pages, and strongly bound in red covers with gilt lettering, make a presentable book which does both Robertsons and the author credit.

"Transactions of the Faraday Society," Vol. I., Part 3, August, 1905. London: The Society, 82, Victoria Street. 10s. 6d.

"Proceedings of the American Society of Civil Engineers," Vol. XXXI., No. 6, August, 1905. Published by the Society, at 220, West 57th Street, New York.

"Molecular Forces and Newtonian Laws." By Alex. Clark, M.A. Glasgow: W. & R. Holmes. 3s. 6d. net. (Ready October 2nd.)

Proceedings of the Incorporated Municipal Electrical Association, 1905. London: Wyman & Sons. Price 3s. 6d.

"Elementary Manual of Magnetism and Electricity." By Prof. Andrew Jamieson. Sixth Edition. London: Chas. Griffin and Co. 3s. 6d.

"Fire Tests with Glass." Red Books of the British Fire Prevention Committee, Nos. 95 and 97. London: The Committee, Waterloo Place, Pall Mall. 2s. 6d. each.

"Wireless Telegraphy." By A. Fredk. Collins. New York: McGraw Publishing Co. $3.

Catalogues and Lists.—The Sterling Telephone and Electric Co. (late Berliner Telephone Manufacturing Co.), of 200, Upper Thames Street, E.C.—We have received a very fine catalogue setting forth in admirable style an extensive collection of all manner of telephonic apparatus. It is a well-bound book of 162 pages, and no attempt has been made to unduly crowd the various devices together. To indicate the contents in detail in this notice is a sheer impossibility, we can only do so roughly by saying that there are parlyphones, "Twencen" domestic combinations, hygienea hand combinations, battery and magneto wall 'phones, table instruments, municipal magneto telephones, intercommunication sets, central station switchboards, central battery 'phones, electric traction and railway service sets, extension instruments, lightning arresters and safety fuses, electric bells, indicators, pushes, door, window and floor contacts, fire alarm contact devices, fire indicators, batteries and parts, wires and wiring sundries, telephone insulators, line construction tools and a hundred or so other things that space will not allow us to even name. A good feature of the book is the collection of diagrams of connections which occupy many pages at the end.

Messrs. Geipel & Lange, London.—Card (for filing) giving an abridged price list of Ward-Leonard motor starters for motors from ½ to 50 h.p. Pressures, code words, catalogue numbers and prices are clearly set out in tabulated form.

Sunbeam Lamp Co., Ltd., Gateshead-on-Tyne.—Card giving hints to users of electric light. If consumers could be persuaded to hang up this card in a convenient position, and study it frequently, they would be able to obtain more efficient illumination, and more economically, than they do at present.

The Positive Rotary Pumps, Ltd., 23, Northumberland Avenue, W.C.—Card showing various designs of their pumps, hand, belt and electrically driven.

The Paterson Engineering Co., Ltd., Amberley House, Norfolk Street, W.C.—Illustrated leaflet "X," showing some of their filtering, softening, exhaust heating and grease eliminating plant. An abridged list of users of Paterson apparatus for power plants is given; it includes a large number of electrical manufacturers and public authorities.

Messrs. E. Kalker & Co., 141, Much Park Street, Coventry.—List of E.K. insulated wires and cables detailing flexibles specially made for motor-cars, motor-'buses and so forth. Rubber-covered and braided high and low tension wires, waterproof braided and other cables, are listed and priced.

Messrs. A. Gallenkamp & Co., Ltd., 19 and 21, Sun Street, E.C.—New list of filter papers for which they hold sole agency for the United Kingdom and the British Colonies.

The Easton Lift Co., Ltd., Broad Sanctuary Chambers, Westminster, S.W.—Catalogue of 45 pp., giving interesting details regarding the Easton electric lifts and various apparatus employed in connection with them. The patent electric safety gate lock, automatic controller, push-button gear, an automatic floor-setting device, are described, and some notes on driving lifts by electric gears follow, indicating the different systems of driving. A full account is next given of the patent tandem cross-over driving gear for electric lifts, as well as some notes of various forms of guides. Both passenger and warehouse cranes, also electric dinner lifts, hydraulic lifts, motor garage lifts, and express electric railway lift machines are in evidence. The very imposing list of users of Easton lifts includes, as our readers will remember, such important undertakings as the City and South London Railway, the New Brighton Tower, Great Northern and City and Mersey Tunnel Railways. The catalogue abounds in interesting illustrations and matter, and, we believe, will be welcomed by those who are responsible for the introduction of such work into private and public buildings. Accompanying the catalogue, we have also received a large postcard giving architects and others some useful figures relating to the number of steps in various heights between floors. The attention of the reader is summoned away from these figures by the pregnant comment, "But why use steps at all?" and he will, no doubt, profit by the injunction to "Use Easton's Lifts." The company is prepared to send a copy of this card to anybody who applies for it.

General Electric Co., Ltd., London, E.C.—New Catalogue of Engineering Supplies (Section E.) In the course of 88 pages there are given descriptions and illustrations of many interesting items, including electric fans, blowers, small motors, motor starters, transformers, portable electric drilling machines, pumps, accumulators, traction supplies, &c. The pages devoted to small motors particularise both continuous and alternating current types, also small motor transformers for voltages varying from 100 to 500. There are several types of motor-starting rheostats illustrated, to suit practically any condition of working, and full particulars and dimensions are given. Another item worthy of attention is the portable electric drilling machine, of which various patterns are illustrated, one being shown with flexible shaft. Polishing and grinding machines are also included as adapted for fixing either to the wall or bench, or with flexible shaft. Among the numerous other supplies listed are reversible automatic lift controllers, including push button controllers. The latter apparatus can be arranged for any number of floors, and to dispense with the lift attendant. The last pages of the list are devoted to traction supplies of every description for the overhead system.

Messrs. Ernest F. Moy, Ltd., Camden Town, N.W.—Price list No. 9, just issued from the press, giving in 28 pp. illustrated descriptions, &c., of their various types of switches, including voltmeter, Acme patent, and quick-break knife switches. Dimensional drawings appear.

Messrs. Mather & Platt, Ltd., Manchester.—Electric locomotive pamphlet, got up in the company's usual excellent style, with neat half-tone illustrations and a few particulars, of locomotives such as they have supplied for the City and South London Railway, for shunting purposes in Sweden, for shunting operations for mines and surface sidings, and for underground mining work.

Linolite Co.—Leaflet giving particulars of the "Linolite" system and fittings. Also the report of a test of Linolite in comparison with ordinary incandescent lamps, made by Mr. D. L. Sands, at the Municipal School of Technology, Manchester; the illumination was measured on a horizontal surface, and the Linolite lamps, while consuming less power, gave an average 56 per cent. greater than the ordinary lamps.

Natal.—The value of the electrical fittings imported into Natal during the six months ending with June last is returned at £19,000 as compared with only £17,000 in the corresponding half of 1904.

Imports of Foreign Telegraph Cables.—Returns just issued show that the value of the foreign telegraph cables imported into this country during August amounted to £2,964, bringing up the total for the first eight months of the year to £35,291, as contrasted with only £23,666 in the corresponding period of 1904.

LIGHTING AND POWER NOTES.

Ashton-under-Lyne.—With regard to the application of the B.G. for a loan of £5,000 for E.L. works at the workhouse, the L.G.B. has written inquiring whether the Guardians considered the question of obtaining a public supply of energy before deciding to install the works, and, if so, on what grounds they desire to adopt the latter course. The L.G.B. also asks whether there are special reasons for lighting the new infirmary and part of the workhouse by electricity, seeing that these buildings are already lighted or fitted for lighting by gas. At the meeting of the Guardians on September 14th, it was stated that "a public supply of energy would cost 2½d. per unit, whereas with its own plant the cost would not exceed 1d." The matter was referred to the Electricity Committee for consideration.

Belfast.—The accounts of the Corporation electric supply undertaking for the past year show that most items of cost have risen. Notwithstanding the increased cost, the surplus amounted to £4,357, on the strength of which the Council recently reduced the charges for lighting and power. The total revenue during the past year was £28,104. The new tramway system will, it is expected, increase the output by 5,000,000 units.

Bourne.—At the request of the Tradesmen's Association, the U.D.C. has decided to consider the question of electric lighting.

Bradford.—The Electricity Committee has at last succeeded in obtaining the sanction of the City Council to the purchase of an automobile for the use of the department. A 10-h.p. De Dion car, at a cost of £290, is to be purchased; a car, however, has been in use by the department for about seven weeks. The total annual cost of up-keep, &c., is estimated at £226. There is a proposal on foot to establish an automobile depôt for the whole of the Corporation departments.

Brixham.—The U.D.C. has accepted the tender of Edmundson's Electricity Corporation for public lighting for 10 months for £500, on the basis of a five years' contract. The gas company's tender was £600 per annum.

Buenos Ayres.—The German Electric Light Co. has made an offer to the municipality to purchase all the energy generated at the refuse destructors when these are installed.—*Review of the River Plate.*

Chester-le-Street.—The R.D.C. on September 14th decided not to consent to the application of the County of Durham Electric Power Supply Co. for E.L. powers. It transpired that the Council had already consented to a similar application made by the County of Durham Electrical Power Distribution Co.—a concern acting in conjunction with the other company—and that the B. of T. required both syndicates to obtain the Council's consent. The Council intimated that it objected to "trafficking" in the E.L. order by companies.

Colwyn Bay.—An electricity works extension scheme, estimated to cost £17,000, is being considered by the U.D.C.

Cradley.—The Empire Electric Co. has given the U.D.C. notice of its intention to apply for a prov. order to supply electricity within the Council's area. The Council has decided to leave the matter in abeyance until it is known what the Halesowen U.D.C. has decided upon in the same matter.

Electricity in Mines.—Important developments are in progress in connection with the Glamorgan Collieries, Llwynypia, in the provision of electricity for power purposes. A generating station is in course of erection, involving an expenditure of £4,000, exclusive of the item in respect of the plant. Electricity is being already utilised at the colliery on a small scale, but ultimately all the haulage and winding operations will be worked by electricity.

Goole.—The U.D.C. has appointed Mr. Walter Emmott as consulting engineer with regard to the E.L. scheme, and instructed him to prepare plans, &c., of a scheme for a steam-driven plant to be erected at once, at a cost not exceeding £8,000.

Hampton Court.—It has been decided to install the E.L. in the Palace at an estimated cost of between £7,000 and £8,000. The Twickenham and Teddington Electric Supply Co. has been awarded the contract for the supply of energy.

Hastings.—The T.C. has decided to charge the following reduced rents for the hire of electricity meters:—Up to 5 amperes' capacity, 10s. per year; over 5 and not exceeding 10 amperes, 14s.; over 12 and not exceeding 15 amperes, 18s.; exceeding 15 amperes, £1.

Hipperholme.—The U.D.C. has asked the Halifax T.C. upon what terms a supply of energy could be obtained from the latter.

India.—From *Indian Engineering* we learn that the statement that the Punjab Government is about to invite tenders for an electric light scheme for Simla is incorrect.

Italy.—Messrs. Odorico, Barosi & Lovati, of Udine, have applied for a concession to put down a plant to utilise the water-power of the River Cosa in the generation of electrical energy for the operation of an electric tramway between Spilimberge and Gemona.

Llanelly.—At a meeting of ratepayers on September 12th, called to consider the E.L. question and the agreement entered into by the Council with the South Wales Power Co., resolutions requesting the Council to drop the scheme, and refusing to sanction the expenditure of £6,000, or any other sum, on what was described as "an experimental scheme," were negatived. The Chairman said that by the agreement the Council kept in its own hands the control of the E.L., and he assured the meeting that the electric tramways scheme was to be carried out.

London.—St. Pancras.—The Finance Committee of the B.C. has decided to apply to the L.C.C. for a loan of £4,833 for acquiring leasehold interests in Great College Street in connection with the electricity undertaking, and £1,965 for arc lamps, &c. It has transferred in the estimates for the forthcoming half-year a sum of £1,400, the cost of the opposition to the Electric Supply Bills, to the electricity account, as it considers that the charge should be paid out of the electricity reserve fund, and not out of the rates. In addition to the 1,000 shilling tickets which the Council is entitled to for its contribution of £100 to the Electrical Exhibition at Olympia, it has been resolved to take at the rate of 3s. per dozen a further 1,000 tickets for distribution. It was reported that a letter had been received on behalf of the Electrical Contractors' Association, referring to the action of the Glasgow Corporation in agreeing not to undertake the wiring and fitting of consumers' premises itself, but to allow 65 contractors in the borough to co-operate in the matter, and asking that a deputation from the Association might be received with a view to a similar arrangement being made with the St. Pancras Council. The Committee has replied that the Council had already resolved to afford its fullest support to the London Borough Councils' proposals on the question.

Lambeth.—At a recent meeting of the B.C. the report of the auditor appointed by the B. of T. upon the accounts of the South London Electric Supply Corporation for the year ending December 31st, 1904, was presented. The overcharge, he stated, which he disallowed in the accounts for the year 1900 of £2,275 to capital for directors' fees had not yet been corrected. The balance-sheet contains unreasonable assets as follows:—Expenses of flotation of company, £37,989; battery of accumulators, £1,618; expenses in connection with issue of debentures, £389. The provision for depreciation, the report continued, is still very inadequate. He certified that the capital expenditure to December 31st, 1904, amounted to £333,486 instead of £335,761 as stated in the accounts. The Supply Corporation has intimated to the Council that it will supply energy to the baths at 4d. per unit as from July 1st last, instead of at 5½d. per unit as hitherto charged, provided the accounts are promptly passed for payment by the committee.

Southwark.—A lengthy discussion on the electricity undertaking ensued at a B.C. meeting last week. The Rev. Councillor Somerville again asked a number of questions in regard to the alleged prosperity of the concern, and stated that in his opinion municipal trading constituted the worst form of monopoly. Several offers have been received by the Council to deal with the undertaking, but the E.L. and the General Purposes Committees' joint report on the subject has been referred back. A sum of £775, being the cost of opposing the County of London Power Bill, is to be charged to the general funds of the borough.

Stoke Newington.—The B. of T. has intimated that as the arrangement between the Islington and Stoke Newington B.C.'s with regard to the supply of electricity in bulk is only a temporary one, it will approve of the Council's entering into and carrying out the agreement for a period expiring on March 21st next. The agreement has been endorsed, accepting such limited approval.

Marylebone.—A failure in the electric supply in the district occurred on Saturday evening last, which resulted in a performance at the Queen's Hall having to be postponed.

Fulham.—A suggestion by the borough engineer that the price of energy be advertised by fixing shields on the arc lamp standards in various parts of the district has been adopted.

Manchester.—In anticipation of a largely increased demand for energy during the coming winter, the Electricity Committee has extended the plant at its city stations and sub-stations. More than £40,000 has been spent during the past few months in making the equipment fully equal to the city's requirements. Of this amount £13,000 has been needed for improving and extending the street mains; and provision has been made for rendering unnecessary any further disturbance of the road surfaces when additional cables have to be laid. The amount actually spent in respect of contracts and work done, during the present year, is about £25,000. Mr. S. L. Pearce, the chief engineer, in a report to the Committee, describes in detail the extensions which have been made at the different stations. At the Dickinson Street station, superheaters have been added to all the boilers, with a view to decreasing the coal consumption and increasing the steam capacity. Two 750-kw. turbines have also been installed for supplying energy for both traction and lighting purposes. It is not possible to add to the boiler capacity at this station, because there is no available space. The Committee, therefore, intend to bring a portion of the high-tension current from Stuart Street, and transform it at Dickinson Street, for use in the city. With this object three 500-kw. motor converter sets have been supplied by Messrs. Bruce Peebles & Co.; and the British Westinghouse Co. supplied the high and low-tension switchgear. Additional switchgear in connection with the five-wire balancers has been supplied by Messrs. Ferranti. The Bloom Street station is in a highly efficient state. No extensions have been made. The plant is working to its full capacity. At the Stuart Street station two new 6,000-h.p. sets are practically completed, and for a week or more, one of them has been running with the town's load very satisfactorily. The six engine sets in the original station have been overhauled, and are in thorough working condition. Additional plant has been provided at several of the sub-stations—at the Polygon (Ardwick), Bennett Street and Stuart Street—so that the Committee may easily deal with the enlarged demands in those localities. Further balancing plant has been installed at Hunt's Bank and Piccadilly, with the object of improving the general distribution of pressure on the network of mains. By far the most important work carried out this year has been the very large extension of the underground mains. No less than 35 miles of fibre ducts have been laid, including spare ways for future extension work. Eight new 1-in. low-pressure feeders have been run to various parts of the city from the Dickinson Street station, so that the Committee will be able to deal with the very greatly increased demands which are sure to be made upon them during the next few years. It is specially interesting to learn that considerable attention has been devoted to improving the mains in the city. The network has been cut up into various sub-districts, with a view to the more easy location of "faults," should they arise. In connection with the electric lighting order for Gorton, which has been taken over by the Manchester Corporation, the bulk of the mains have been laid, including those required for street lighting in Hyde Road, Wellington Street and Cross Street. The reduction in price for lighting from 5½d. to 4½d. per unit comes into force on October 1st, and the Committee anticipate a greatly increased demand for energy in consequence.

Niagara Falls.—On September 9th a fire occurred in the wire tower of the Niagara Falls Hydraulic Power Co. Several power conduits were destroyed, and for a time most of the city was plunged in darkness. The plant of the Pittsburg Reduction Co., who manufacture aluminium, was damaged to the extent of £2,000.

Ossett.—With respect to the Corporation's application for a loan of £8,400 for the establishment of electricity works, the L.G.B. has intimated that the Council should be prepared at the inquiry to produce evidence to show that there is sufficient demand for energy to justify the execution of the proposed works. At a meeting of the T.C. on September 14th, by the casting vote of the Mayor, a resolution was carried in favour of withdrawing the application for the loan.

Penarth.—The U.D.C. has resolved to convert 80 16-c.p. gas lamps into Nernst electric lamps of 32-c.p., which the Penarth Electric Lighting Co. offer to supply and maintain for 3,600 hours per annum at a cost of £2 14s. per lamp, as against £2 14s. 8d. previously paid for gas.

Radcliffe.—The U.D.C. has fixed amended charges for the supply of energy as under:—Lighting: Not exceeding 250 units per annum, 5d. per unit; exceeding 250 and up to 500, 4½d.; exceeding 500 and up to 1,000, 4¼d.; over 1,000 and up to 1,500, 4¼d.; from 1,500 and up to 2,000, 3¾d.; over 2,000, 3½d. Power: Not exceeding 60 units per B.H.P. per quarter, 2d. per unit; exceeding 60 and up to 125, 1¾d.; exceeding 125, 1½d.; heating, 2d. per unit.

Ramsbottom.—Messrs. Callender's Cable and Construction Co. has commenced to open up the streets in the district for the purpose of laying electric mains for the Lancashire Electric Power Co. The mains are to be laid from the Tottington boundary to the Rawtenstall boundary, a distance of a little over four miles.

Ravensthorpe.—The E.L. Committee of the U.D.C. has decided to consult Mr. Mountain, of Huddersfield, with respect to proceeding with the E.L. order.

Reigate.—An inquiry was held by the L.G.B. recently into the application of the T.C. for sanction to borrow a further loan of £4,000 for purposes of electric lighting.

Rostrevor.—A meeting of the ratepayers is to be held to ascertain who would be willing to take up a supply of electricity if it were provided for the town. A Belfast firm has expressed to the local authority its desire to erect a plant in the district.

Runcrana.—Electric lighting is to be adopted for the public lighting of the town, the supply to be given by a local company.

St. Andrews.—On the invitation of the Electric Supply Corporation, a gathering took place in the Town Hall on the 15th inst., when the electric light and power scheme for the city was formally inaugurated.

St. Annes-on-Sea.—The U.D.C. has sent a circular letter to the municipal authorities owning electrical undertakings, asking that the L.G.B. be requested to allow the expenses of delegates to the conferences of the Incorporated Municipal Electrical Association.

Saffron Walden.—The T.C. has received from the B. of T. an intimation that the Board is not prepared to sanction the agreement between the Corporation and Messrs. Foote and Milne for E.L. The Council has informed Messrs. Foote & Milne that it is willing to consider any proposals from them for carrying out the installation.

South Africa.—Aliwal North.—The electric light was recently switched on at the Town Hall, and the Mayor stated that very shortly the whole of the town would be lighted by electricity.

Bloemfontein.—Assent has been given by the Governor to an ordinance regulating the employment of electricity for E.L. and power purposes generally.

Stratton and Bude.—The U.D.C. is considering the E.L. question. Messrs. Christie intend applying for a prov. order, and the Council has deputed Mr. Foster Melliar to deal with the matter, the Council being favourably disposed towards the scheme.

Sudbury.—At the meeting of the T.C. on September 13th it was reported, with reference to the E.L. order, that the B. of T. could not revive the order, that it could not grant a new order without charging the usual fees, but that it could, and in all probability would, grant an order on the understanding that it would be transferred to a reliable company, which would pay the net costs of the order.

Swindon.—The T.C. has received from the L.G.B. sanction to raise a loan of £2,862 to cover excess expenditure in connection with the electricity undertaking.

Swinton and Pendlebury.—The difficulty as to the agreement with the Lancashire Electric Power Co. relative to the E.L. scheme has been removed by the decision that the agreement does not involve a divestiture by the Council of any of its legal powers and liabilities under the E.L. order, and the completion of the agreement is to be proceeded with by the U.D.C.

Thornaby-on-Tees.—The T.C. has confirmed an agreement to transfer the Corporation's E.L. powers to the Cleveland and Durham County Power Co.

Truro.—The T.C., having communicated with four companies respecting the E.L. scheme, has asked the Electric Supply Corporation, Ltd., which supplies the neighbouring town of Falmouth, its terms for supplying Truro if the Council obtains a prov. order.

Willington.—The County of Durham Electric Power Distribution Co. has asked the U.D.C. to consent to its application for a prov. order for E.L., and also to the use of overhead mains. The company offers to supply energy at 3¾d. per unit, less 5 per cent. The Council has deferred its decision.

Windsor.—The R.D.C. has decided to ascertain from Messrs. Foote & Milne, who are applying for powers to supply energy to Sunningdale and Sunninghill, the maximum cost per unit proposed to be charged, and the probable cost of public lighting by electricity.

Zanzibar.—It is stated in the *Sun* that electric light is being installed in the streets of Zanzibar, and an American firm has obtained a concession to construct a light electric railway, the first in the country.

TRAMWAY AND RAILWAY NOTES.

Aberavon.—The U.D.C. has again decided to support the electric tramways scheme to be brought forward in the next Parliamentary session by a syndicate. On the last occasion the Lords' Committee overruled the consent of the B. of T. The last scheme was promoted without the consent of the Glamorgan C.C.

In connection with this tramway scheme, Sir Herbert Jekyll recently stated that, in view of the decision of the Lords' Committee that the promoters of the Aberavon tramway scheme must obtain the consent of the Glamorgan County Council before embarking on their scheme over the main road in the borough of Aberavon, the Board of Trade had submitted the question to the law officers of the Crown. These gentlemen returned an opinion that, in dispensing with the consent of the County Council in the case of the Aberavon order, the Board of Trade were acting within their power. The Board of Trade will, accordingly, in any similar case arising in future, rely upon this opinion of the law officers of the Crown, and not be bound by the decision of the Select Committee.

Bristol.—A Bristol coroner's jury on Monday, after finding a verdict that M. G. Monks was accidentally killed by being run over by an electric car on one of the Bristol Co.'s lines, added that no blame was attached to the driver or to anyone, but they thought the company should carry, or have at different points on the routes, jacks of sufficient power to lift the end of a car, as this was so often a matter of life and death. The case was one in which the deceased, a little boy, ran from a shop right in front of a quickly-advancing car. All the witnesses were agreed that the driver could not have prevented the accident, but there was some question whether the car should not have pulled up quicker considering the brake power that was applied, and why the automatic lifeguard did not drop and pick the boy up, instead of his passing beneath it and being carried along by the vehicle.

Croydon.—The Corporation on Monday agreed to apply for sanction to borrow £7,000 for the construction and equipment of the proposed tramway from High Street, South Norwood to Penge. It was further resolved to push forward the extension from Thornton Heath to Gloucester so as to provide work during the coming winter. It was reported that the leases of the tramway undertaking to the British Electric Traction Co., Ltd., were to be determined from May 31st next. The necessary notices had been duly served. Subsequently a letter was read from the company offering terms for the renewal of the leases. The conditions were (1) an increase in the yearly payment on the expenditure of the Corporation from 6½ to 7 per cent., representing an increase of £1,187 on the amount now paid; (2) increased yearly payments on repair of roads; a further yearly sum equal to 25 per cent. on net profits realised from the working of the lines; (4) the electrical energy for working and lighting to be supplied by the Corporation at 2d. per unit; the new lease to be for a period of 21 years, terminable at the end of 7 or 14 years. The letter was referred to the Tramways Committee.

Cleckheaton.—Bradford T.C. has informed the U.D.C. that it is proposed to construct electric tramways from Odsal through Lowmoor to the city boundary as Oakenshaw, and has asked the U.D.C. what they would be prepared to do as to the construction of lines in their district to afford facilities for through traffic between Odsal and the Spen Valley lines. The matter has been referred to a committee.

Drighlington.—At a meeting of the U.D.C. on September 13th, it was stated that a year's extension for constructing the electric tramways in the district had been granted to the B.E.T. Co.

Hythe (Kent).—The T.C., after considering the proposals of the Traction Corporation, Ltd., for tramways to the town from Folkestone to Sandgate on the Kingsland surface contact system, has decided under no circumstances to provide any portion of the cost of the promotion of a Bill, or of the cost of construction of the lines.

Peru.—The Government of Peru has approved the plans for a new electric railway in Lima. According to the *Financial News*, electrical equipment on street railways is giving such excellent results in Peru that steam railroads are about to change their motive power to electricity, utilising water power wherever available. It is stated that the railway at Callao has been experimenting successfully, and that it is ready to abandon steam and equip all its lines with electricity.

Liverpool.—Last week the foundation stone of the new tramway offices of the Liverpool Corporation was laid by Sir Charles Petrie with appropriate civic ceremony.

(*Continued on page 468.*)

ELECTRICITY IN A CATHEDRAL.

Electric light has long been adopted in churches as the light *par excellence*, and it will be interesting to indicate to what extent electricity has been made use of in the new cathedral that was inaugurated in Berlin a short time ago. The installation includes a complete electric light and power plant, installed by the Allgemeine Elektricitäts Gesellschaft, and connected to the mains of the Berlin Electricity Works.

Those entering the cathedral from the vestibule, lighted by arc lamps, will be favourably impressed by the indirect illumination, which, in its present form, has been used here most likely for the first time. This illumination is due to arc lamps arranged in hidden places above the cornices in the main cathedral, on the galleries of the cupola, which by reflectors distribute uniformly throughout the vast hall the beams of light, softened by diaphragms. These effects are added to by illuminants of the same kind, throwing their light upwards from magnificent candelabra placed in the aisles, and preventing the formation of any disturbing shadows. With the light of these arc lamps, softly diffused from the roof, is mixed that of hundreds of glow lamps mounted on the same candelabra, as well as on brackets and chandeliers.

Nernst lamps have also been used in the cathedral, shining in 52 candles from the altar niches, and filling with their soft glow the vaults of the Hohenzollern crypt.

The electric lighting plant of the cathedral, throughout its halls and even outside the church proper, includes at present about 1,900 glow lamps of 15 to 25 normal candle-power, upwards of 100 Nernst lamps and about 70 arc lamps of 6 to 15 amperes. All these have been installed by the Allgemeine Co., the total length of wire used amounting to about 25 km.

The motive power plant includes six electric drives, one of which (10 h.p.) actuates the organ blowers, while two 9-h.p. motors are set apart for the bell work and the remainder for fans and a lift. The organ motor works at 1,175 r.p.m. on a high-pressure blower yielding 96 cb. m. per minute at a pressure of 200 mm. water column in the organ reservoir, and is actuated by a starter placed close to the keyboards.

Interior of the Cathedral, Berlin, Illuminated with Electricity.

The mechanism employed to ring the three bells of the cathedral is especially noteworthy: it consists of a long electrically-driven shaft to which three disks have been firmly keyed, each corresponding to one of the bells. Beside each of these disks is placed a loosely running drum carrying the end of the ringing rope. The drum is pressed by a special mechanism against the rigid disk, so as to partake of its motion, when the rope being wound up will actuate the bell. The same mechanism afterwards separates the disk and drum, so that the rope being wound off can follow the swing of the bell to the other side. This alternate throwing in and out results in the bells giving out their powerful sounds.

F

WILLANS & ROBINSON'S TURBINES AT GLASGOW.

We are able this week to give interesting illustrations of one of the turbines which the Glasgow Corporation has recently installed in one of its stations; the turbine is of 1,400 KW. capacity, and is arranged for driving two Siemens direct current generators of 700 KW. each in tandem.

In addition to the above plant, Messrs. Willans & Robinson, Ltd., are at present engaged in erecting for the Glasgow Corporation two further sets of turbines of 3,000 KW. capacity each, for coupling to alternators of Messrs. Dick, Kerr & Co.'s manufacture.

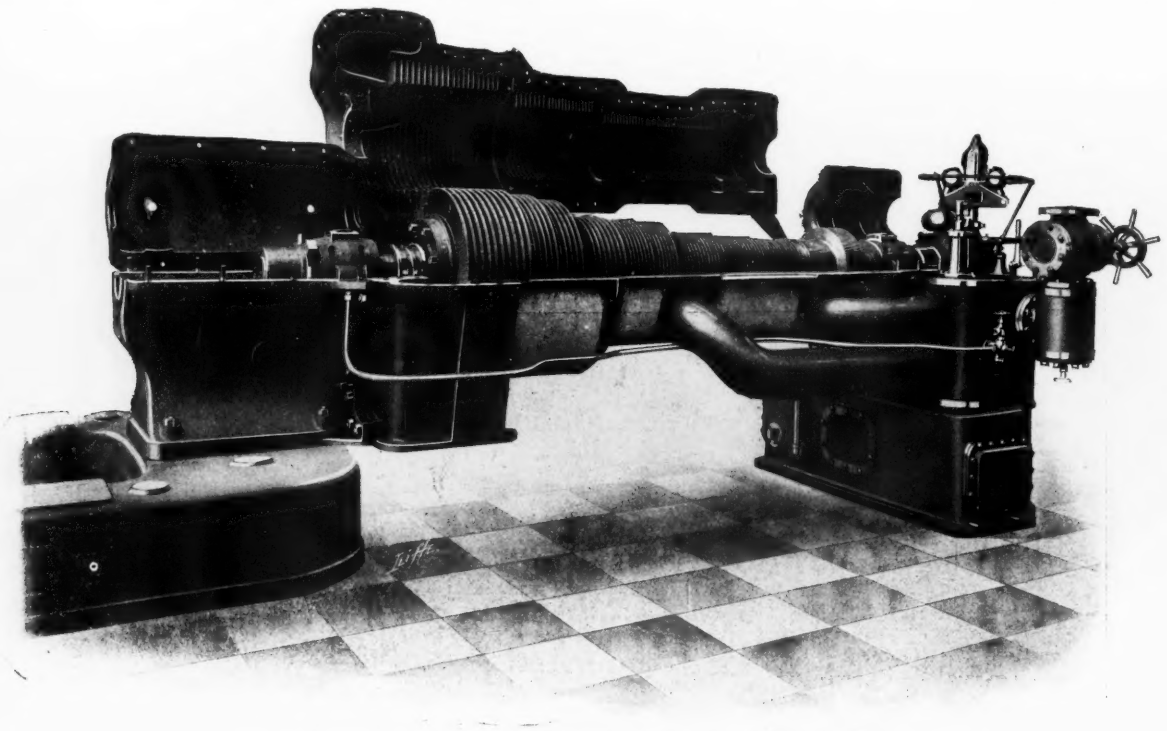


Fig. 1.—Willans & Robinson's Steam Turbine, Opened up for Inspection.

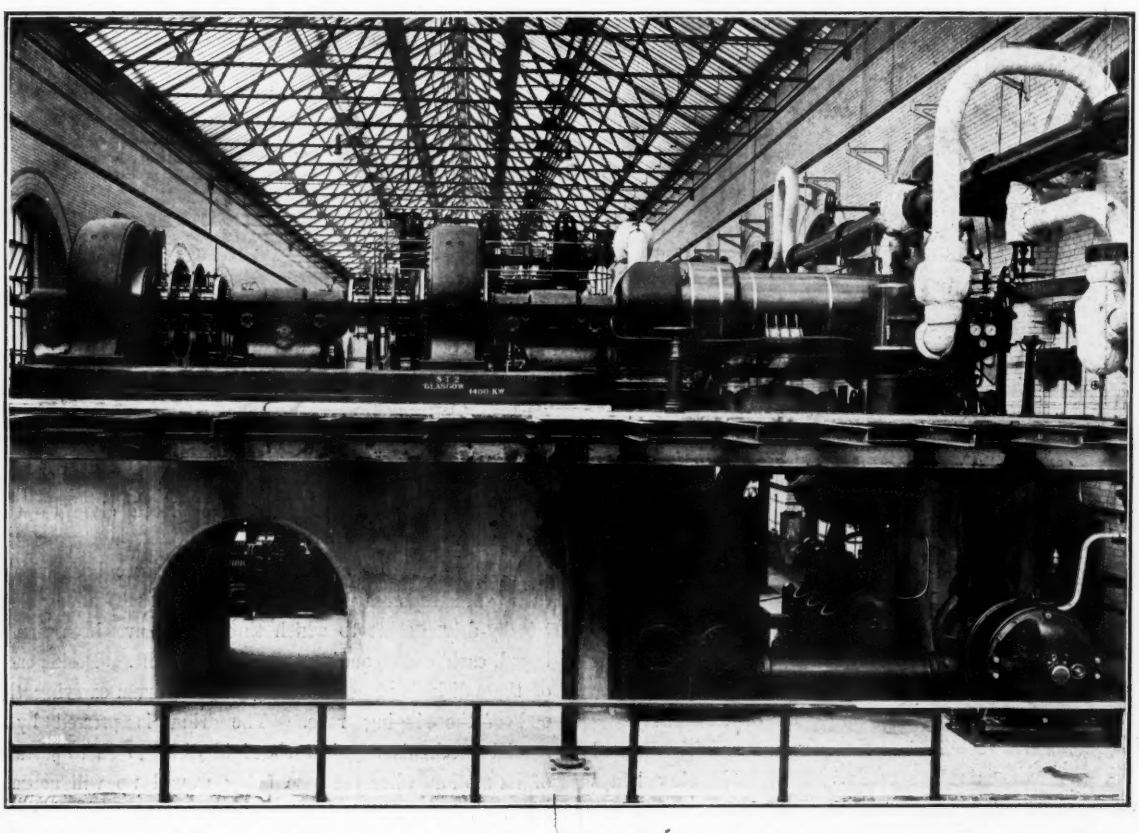


Fig. 2.—Willans & Robinson 1,400-KW. Turbine Coupled to Siemens Dynamos, in Glasgow Corporation Electricity Works.

The smaller set of 1,400 KW. capacity is perhaps of special interest in that direct current dynamos have hitherto been a source of difficulty from the point of view of

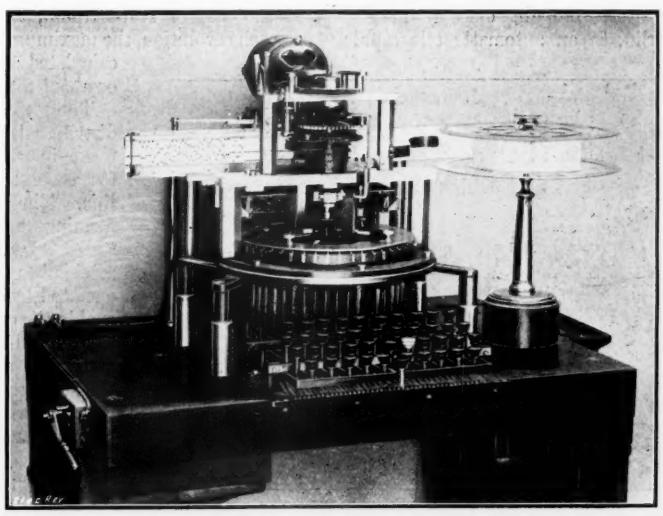
commutation, and carbon brushes have been looked upon almost as an impossibility when running at these high speeds.

The two dynamos in question are entirely fitted with carbon brushes, and it is difficult to tell, so far as commutation is concerned, whether full load or no load is being dealt with.

Another point of special interest in fig. 2, is the view given of the condensing plant, which is of the surface type.

The arrangement shown is a good illustration of how a surface condensing plant can be arranged underneath a turbine of this type, and yet be very accessible for purposes of inspection and adjustment.

The details of the turbine itself are not very clearly shown in fig. 2 in consequence of many of them being collected at one end of the turbine, which is hidden behind the steam pipe; a better idea of these details will be obtained from fig. 1, which shows a turbine opened up for inspection purposes.



[Siemens & Halske Printing Telegraph: Fig. 1.—Perforating Apparatus.
(See p. 466.)

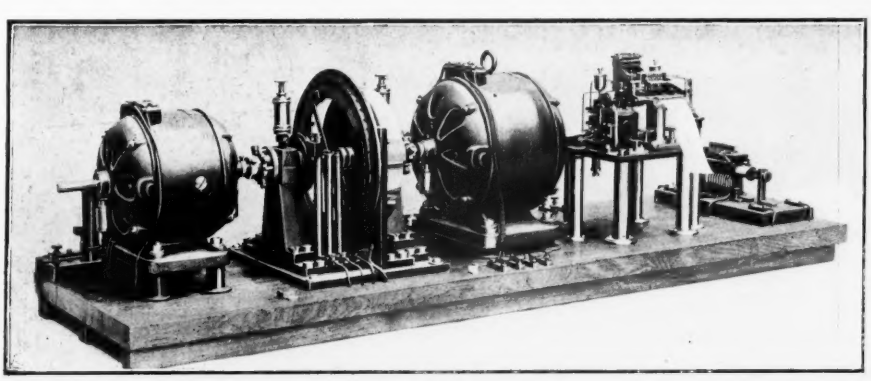


Fig. 2.—Transmitting Apparatus.

From the point of view of accessibility, the turbine has been designed with a good deal of forethought, and it is found possible in the course of 10 to 15 minutes to completely open up all the working parts, including the removal of the bearing caps. Whilst it is unlikely that this operation will often be necessary, it is an advantage well worth having, seeing that it is obtained without any sacrifices. The convenience is, of course, made possible by fixing the governor gear, throttle valves, &c., not on the turbine proper but, in the case of the governor gear, on a continuation of the end bearing, and in the case of the steam chest and throttle valves, on one side of the turbine, where they are supported independently of the turbine proper.

Fig. 1 shows on close inspection the channel shrouding round the blades, into which the blades are fixed and riveted. This shrouding is of great assistance in protecting the blades, and in preventing them coming to an untimely end, in the event of contact with the case. The shrouded blades have on several occasions come into contact with the case, but with no more serious result than that, at the point of contact, a small portion of the shrouding has been ground off.

We hope, after the larger 3,000 kw. turbine sets have been put to work, to have an opportunity of describing them in some detail. In the meantime,

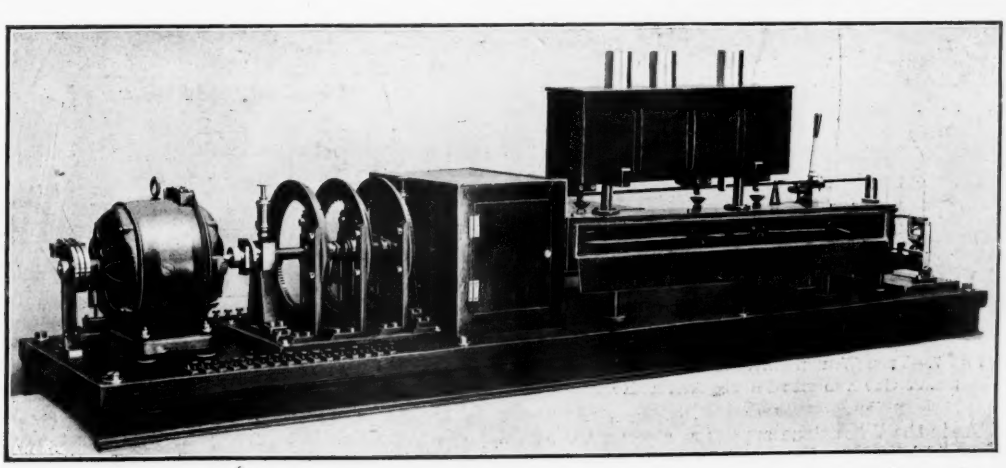


Fig. 3.—Receiving Apparatus (Complete).

we congratulate Messrs. Willans & Robinson upon their successful *début* in the manufacture of large turbines.

THE SIEMENS & HALSKE PRINTING TELEGRAPHIC APPARATUS.

By EMILE GUARINI.

The printing telegraph lately brought out by Messrs. Siemens & Halske, of Berlin, is an automatic telegraphic system. As in the Wheatstone apparatus, a perforated band is first prepared by means of a special apparatus termed a perforator. This band is introduced into the automatic transmitter, where the holes in the paper cause alternately positive and negative discharges into the line. In the receiver a strip of photographic paper is unwound in a dark chamber in front of a type wheel, upon the periphery of which the letters of the alphabet are perforated. This wheel moves synchronously with the transmitter: at the moment when the letter transmitted passes in front of the sensitive strip, an electric discharge takes place between the spheres of an oscillator, and the letter is photographed. As the type wheel revolves at the rate of 2,000 r.p.m., and as a letter can be printed at each revolution, the maximum speed of transmission can be calculated at 120,000 letters per hour, or about 20,000 words.

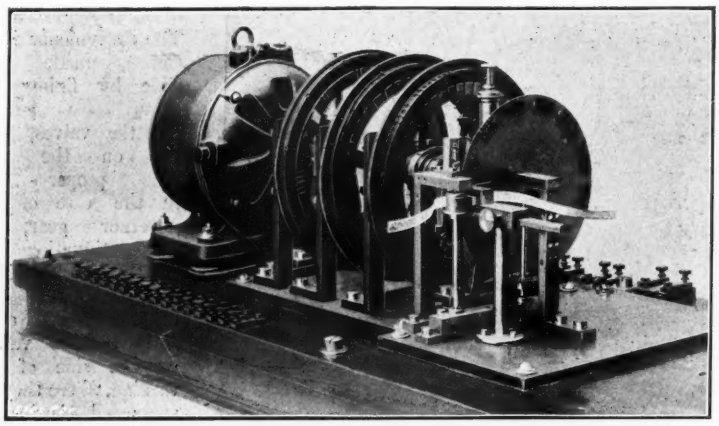


Fig. 4.—Receiving Apparatus, End View

The perforator is composed of styluses distributed in a suitable manner, which make in a strip of paper two holes for each letter, following an oblique line. The styluses are operated by keys forming a keyboard like that of a typewriter (fig. 1, p. 465), and the mechanism for moving the paper is operated by a small electric motor. To enable the operator to decipher the band, there has been added to the perforator a system of printing like that common to the typewriter.

The transmitter, fig. 2, is provided with a part where the strip bearing the message is introduced. This strip, pulled along by an electric motor, runs in front of a system composed of 11 springs, to which as many contacts correspond. The apparatus is completed by a transmitting disk, the object of which is to give perfectly distinct signals whilst regulating the discharges. The perforations are slightly delayed one behind the other; they produce negative and positive discharges succeeding at intervals of time determined by the position of the holes. These latter, as shown in fig. 9, p. 467, are in perfect alignment in a longitudinal direction, following imaginary horizontal lines to the number of 11

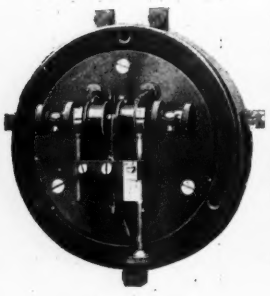


Fig. 5.—Relay.

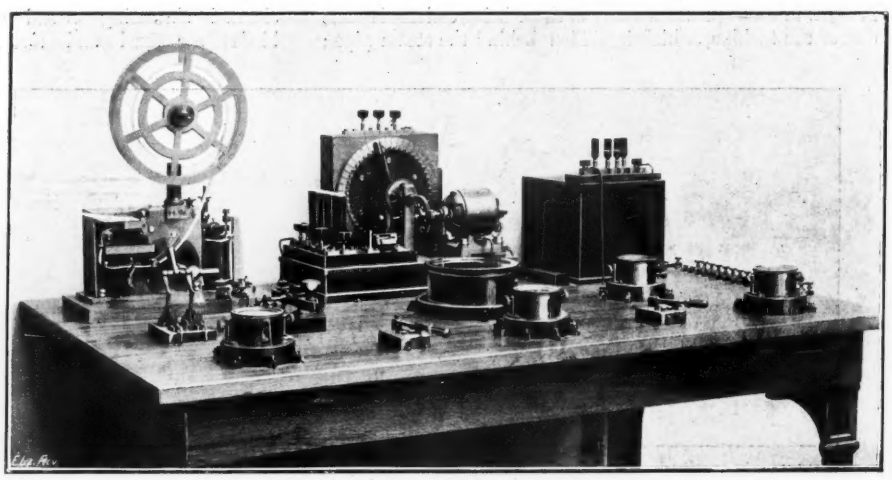


Fig. 6.—Auxiliary Apparatus.

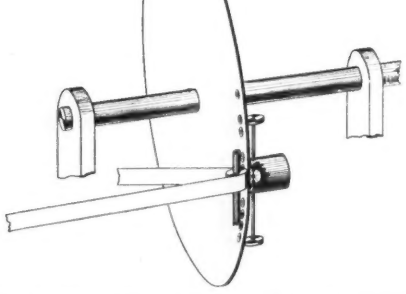


Fig. 7.—Type Wheel Revolving Between the Spark Gap and the Photographic Tape.

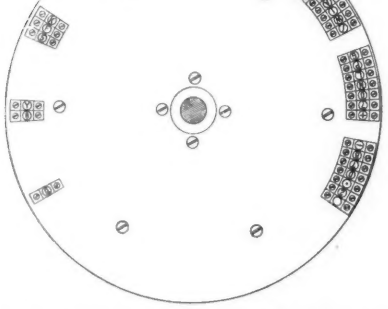


Fig. 8.—Arrangement of the Letters on the Character Disk.

equal to the number of springs. Each spring terminates in a pin, oscillating between two stops, and is connected to the segment of a contact fixed on the periphery of a transmitting disk, which is concentric with the axis of the motor; this disk is fixed, but a brush, moved by the shaft, rubs upon the segments (fig. 10). When the strip has no perforations, the springs are held against the upper stops; but immediately a hole passes in front of one of the springs it is released, and bears against the lower contact or terminal in contact therewith. If there were used direct for working

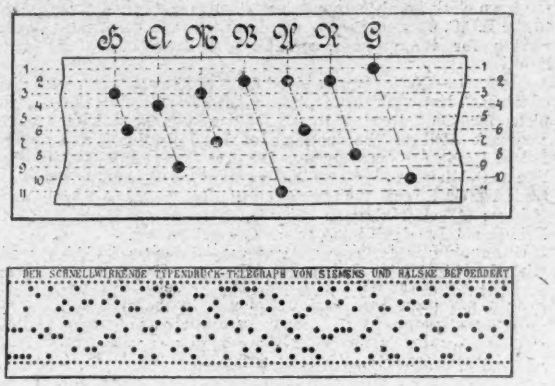

DER SCHNELLWIRKENDE TYPENDRUCK-TELEGRAPH VON SIEMENS UND HALSKE BEFORDERT
DURCHSCHNITTLICH 2000 ZEICHEN IN EINER MINUTE UEBER EINEN DRAHT UND IN EINER RICHTUNG.

Fig. 9.—Examples of Perforated Tape.

a discharge resulting from this contact, a precise transmission could not be obtained, the duration of the discharge being too long, and hence it was found necessary to have recourse to the transmitting disk. When the spring has been lowered, it is still necessary, in order that the transmitting relay may be placed in operation, that the arm of the disk shall pass over the segment corresponding to the spring flexed. The line is then, for an instant, traversed by a positive current, which is produced by means of a small generator mounted upon the shaft of the motor. The brushes of this generator are connected by a resistance, the central point of which is earthed, thus enabling a positive or negative current to be sent along the line by the simple oscillation or balancing of the armature of the relay. Should the brush of the disk rub against a segment, the

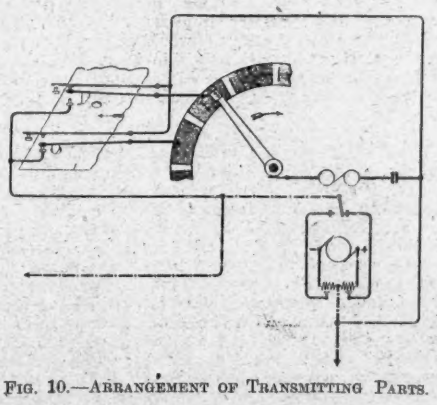


Fig. 10.—Arrangement of Transmitting Parts.

spring of which is lowered, then a circuit is established which charges the reversing condenser; the armature of the relay will not move for a current having this direction, but directly the brush touches the following segment, the spring of which is raised, the reversing condenser is discharged, and a discharge contrary in direction to that which first prevailed in the relay now circulates in the latter, and its armature effects the transmission over the line of the negative current emanating from the generator. Upon another perforation following the first, a spring will be released, the reversing condenser will be charged negatively, and the armature of the relay will not move. With the following segment the discharge will take place and cause the displacement of the armature, thus sending negative current into the line. The latter is traversed by positive and negative currents, the duration of which depends upon the positions of the perforations in the strip.

Perfect synchronisation between the transmitter and the receiver is obtained by means of a regulating apparatus, the operation of which is both electrical and mechanical. The synchronising mechanism consists a small regulating motor and a regulating disk.

The line currents are received in a relay which operates the automatic receiver, which comprises a motor, the shaft of which rotates at 2,000 r.p.m. in synchronism with the transmitter; four disks, two of which are made to agree with each other, and are intended to produce a rapid electric discharge for printing purposes; and the type wheel, upon the periphery of which there are distributed in nine groups small pieces upon which are cut the letters, &c. (fig. 8). Each disk has nine contacts. The type-wheel rotates between the balls of an oscillator and a photographic strip. The balls, the type-wheel, the strip and the mechanism for moving the latter are all placed in a dark chamber, as shown in fig. 3, p. 465. There are four disks, the first being the charging disk. It carries nine contact segments, each of which communicates with a separate condenser. A brush rotates in contact

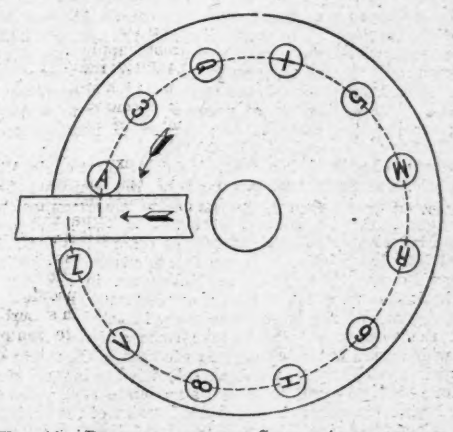


Fig. 11.—Diagrams showing Spiral Arrangement of Letters.

with the segments. A positive current in the line relay causes the armature to take up such a position that the condenser corresponding to the segment that touches the brush is charged. The second or discharge disk is in accord with the third or connecting disk; upon its periphery there are arranged nine groups of contacts. The first contact of each group communicates with the first condenser; the second with the second condenser, and so on. A primary selection is made on charging, so that, thanks to the synchronisation, either the one or the other of the condensers is charged. If No. 3 condenser is charged, the letter transmitted will be one of those corresponding to the third segments of the groups of the discharge disk. A negative discharge on the line causes the armature of the relay to oscillate, and this brings it into the discharging position. The second selection now comes into operation, *i.e.*, this oscillation of the armature takes place at the moment when the brush passes in front of the group which contains the charged segment corresponding to the letter transmitted. The discharge is produced by the agency of the disk, the connecting relays and the oscillating relay; it traverses the primary winding of a coil which by induction charges the spheres of an oscillator inserted in the circuit of the secondary winding; a very brilliant spark is produced between these spheres.

The type wheel carries nine groups of letters, corresponding to the groups of contacts of the discharge disk. These letters are cut in copper strips, and they are not arranged at a fixed radius, but in a spiral form (fig. 11). This mode of construction is explained at once if it be remembered that the sparks occur at unequal intervals of time,

whilst the strip is being uniformly unwound. By this very simple means, signals placed at an equal distance from each other are secured.

TRAMWAY AND RAILWAY NOTES.

(*Concluded from page* 462.)

Australia.—New South Wales.—According to the report for the year ending June 30th, the number of miles of line open for traffic on June 30th was 125¾, and the amount spent on construction and equipment £3,637,922. Of this sum £22,455 was paid from the consolidated revenue, and no interest is payable thereon. The interest due on the capital invested, calculated at 3·582 per cent. (the average rate of interest on the State debt), amounts to £129,506, and the earnings, after paying working expenses, to £127,887, being £1,619 short of the sum required to pay interest. The earnings show an increase of £10,584, and the expenditure an increase of £12,057, the net result being a decrease of £1,473. A sum of £109,038 has been expended during the year in maintenance and renewals of the permanent way and works, and charged to working expenses. Of this amount, £26,668 represents the cost of relaying portions of the permanent way and other renewals of a special character. A sum of £17,802 for new cars was charged to working expenses. Since the introduction of electric working, stock has been replaced by new electric cars charged to working expenses at a cost of £128,779. In the maintenance and renewal of plant and cars, a sum of £157,100 was expended during the year, and charged to working expenses. The electric plant at the Ultimo power house, including an additional unit consisting of a turbo-generator set, which was installed in January last, has worked satisfactorily. The total output for the year was 33,555,887 kw.-hours, of which the alternate current supply was 19,110,640 kw.-hours, and the direct current 14,445,247 kw.-hours. Of the total output, 3,359,080 kw.-hours were used for other than traction purposes. The percentage of working expenses to earnings was 84·28; earnings per car-mile, 1s.; number of passengers carried, 139,669,459; and car-mileage, 16,413,762.

Victoria.—Mr. F. E. Bradford, electrical expert of the Victorian Railway Department, was examined by the Railways Standing Committee recently on the question of electric tramways and electrification of the St. Kilda Railway. Melbourne had only 150 miles of tram lines, while the average of other cities was 1 mile for every 2,000 of population. It was fair to assume that 300 miles of tramways could be operated in Melbourne, in addition to the suburban railways, which carried about 50,000,000 people annually. As a safeguard of the large sum already invested in suburban railways, the Government should take some action to control tram lines which could be made to serve as feeders to the railways. He had picked out from the proposals submitted to him six tramways, which he believed could be built at a moderate cost, and would be a fair business investment. If the conversion of the St. Kilda line were taken in conjunction with the tram lines, a power house could be built, centrally situated, and large enough to generate power economically. All the suburban railways should be electrified. The cost of constructing a central generating plant of 2,000 kw. would be £60,000. The line from Port Melbourne to St. Kilda would cost £21,175 to construct; the operating expenses would be £4,197, and the receipts he estimated at £4,608, leaving a profit of £411 per annum.

The cost of the Prahran-Malvern line would be £28,815, exclusive of the power station, divided as follows:—Permanent way and overhead construction, £12,600; six cars, £5,400; high-tension line, £850; sub-station, £2,400; car-shed, £400; 10 per cent. for contingencies, £2,165. The annual milage would be 236,500, and the power required 354,750 units, costing £740. The total operating expense for a 10-minutes' service, maintenance, administration and interest would be £5,562, and the estimated revenue £11,825. Mr. Bradford considered that the annual profit on this line would be £6,263.—*Electrical Record.*

The proposals are summarised by the *Australian Mining Standard* as follows:—Miles of tramway (single track), 22·7; anticipated gross revenue (without St. Kilda), £49,834; gross operating cost (including interest), £35,222; net annual profit, £19,242, or 7½ per cent. net profit on the whole undertaking after paying interest on the capital required. The power house would be on the south side of the Yarra, near the river, where coal and water could be readily obtained.

Adelaide.—On December 14th, 1904, the Government gave the Adelaide and Suburban Tramway Co. notice, under the Tramway Electric Traction Act, 1904, of its intention to purchase the whole of the tramways and undertakings of the company. The company asked £235,950, but the Government did not agree, and the matter was referred to arbitration. The arbitrators, according to the *Australian Mining Standard*, asked the Supreme Court to settle the principle upon which the purchase money was to be estimated. The company contended that the arbitrators were to determine the price of the whole of the tramways and undertakings as a going and profit-making concern, including the statutory powers, privileges, and revenue-earning rights. The Government insisted that all the company was entitled to was the value of what it had to sell. The judgement of the Court upheld the contention of the company, and decided that the Government must also pay the profits which the company would have earned, until the terms of the current periods expire in 1909, 1910 and 1911.

London.—Fulham.—The Works Committee of the Borough Council reported on Monday having received a letter from the B. of T. intimating that after careful consideration of the objections put forward by the Borough Council and the L.C.C.'s. reply thereto, the Board had approved of the plans submitted by the L.C.C. for the tramways in Fulham Palace Road and High Street, Fulham. In subsequent communication the Board stated that in view of the representations made by the Borough Council, the Board had no objection to any modification of the plans that may be agreed to by the parties concerned in connection with matters relating to the mode of construction or the electrical arrangements which had been mentioned in correspondence with the department. Having regard to the foregoing communication, the town clerk had been requested to make further representations to the L.C.C. strongly urging the desirability of substituting wood paving for the proposed granite setts between the tramway lines.

Lambeth.—Notice was received from the B. of T. at the meeting of the B.C. last week that the Board had approved of the L.C.C. plans for the following lines (1) from Camberwell Green *viâ* Denmark Hill to the junction of Lordship Lane and Crystal Palace Road; (2) junction from No. 1 at Denmark Hill to existing line at Coldharbour Lane; (3) electrification of existing tramways from North Street, Wandsworth, *viâ* York Road, to Westminster Bridge; (4) electrification of existing tramways from Lambeth Bridge, *viâ* Lambeth Road, to St. George's Circus.

Underground Electric Railways.—Progress is being made with the substitution of electric for steam trains, and there are now but few of the latter in use in the tunnels. The Inner Circle service has been got into operation, and the Metropolitan has practically completed its scheme of electrification. The District Co. still requires a further number of electric trains before the whole of the steam trains can be withdrawn.

New Zealand.—Hutt.—Proposals for the establishment of a tramway service for the borough have been laid before the B.C. by the Christchurch Electrical Construction Co.

Christchurch.—The annual meeting of the Tramway Board was held a few months ago. The chairman stated that a further sum will be required to complete the work of construction now on hand. The increase in expenditure includes the conversion of the old cars to trailers, &c, the total amounting to £29,822; less interest and rates, £10,359; £19,463. With the consent of the ratepayers the Board has power to raise a second loan of £100,000, which it is suggested should be expended as follows:—£25,000 for completing present work in hand; £25,000 for new rolling stock; and £50,000 to be applied to supplying services to an increased area.

The Tramway Board in July last approved of several proposed amendments to the Tramways Act, including the limitation of liability for damages in connection with accidents to £2,000. It was decided to consider the flotation of a second loan of £100,000, and the traffic committee was asked to report on what extension of the present system should be made.

Wellington.—A report by a Swiss expert, M. Edmund Allo, dated March 2nd, 1903, was presented to the New Zealand Parliament in July last, in regard to the substitution of electricity for steam traction on the Government railways. The cost of equipping the track he estimates—for the trolley wire and bonding—£300 per mile.

Wellingborough.—Last week the County of Northamptonshire Electric Power and Traction Co. were summoned for disobeying an order to abate a smoke nuisance. The clerk to the U.D.C. prosecuted. A representative of the company asked that the case might be adjourned for three months in order to allow the company to carry out necessary alterations. Plaintiff said he had no objection providing the company would enter into an agreement to make the necessary alterations within three months to obviate the nuisance, the company to pay the costs of the action. The company agreed to this, and the case was adjourned for three months.

United States.—Brooklyn Rapid Transit Co.—The annual report of this company for the year ending June 30th was published on September 9th, showing a net gain in receipts of £106,000. There has been a large expenditure lately in improving structure and rolling stock, 100 new elevated cars, driven by 440-h.p. motors, and 87 new convertible winter and summer cars having been acquired. The new Williamsburg power station is approaching completion. One 7,500-kw. turbo-unit and one 5,500-kw. unit will be installed about the end of this year, and a third unit of 7,500 kw. capacity is to be put in before next summer. This station is designed to have an ultimate capacity of 100,000 kw. Five sub-stations have each been fitted with an additional 1,000-kw. rotary converter, with static transformers and switchboards. A new sub-station of Myrtle Avenue is nearly ready for use, and will have four 100-kw. rotaries. The B.R.T. Co. has been experimenting with oil on its tracks, especially along the streets in those suburbs where mosquitoes are frequent. Ex-Judge Alton B. Parker has been appointed chief legal counsel for the company at a salary of £20,000 a year. Mr. Parker was democratic candidate for the U.S. presidency last autumn.

Erie Railroad.—The Hall Signal Co., of New York City, has received an order to install electrically-operated semaphore signals on a considerable portion of the Erie Railroad. The cost of the installation will be £45,000.

Lowestoft.—The T.C. has applied to the B. of T. for a loan of £13,632, the amount of excess expenditure over sanctioned loans in connection with the electric tramways.

Llandudno.—An extension of four months in which to complete the electric tramways has been granted by the B. of T. The U.D.C. has waived the demand for a deposit of £1,000 by the tramway company as a guarantee that the work will be completed by the end of the year.

Maidstone.—The T.C. has decided to apply for powers to extend the electric tramways to Loose *via* Mill Street and Knightrider Street and to Tovil *via* King Edward Road.

Isle of Man.—A serious accident, involving injury to seven persons, occurred on Thursday last week on the electric railway which runs from Laxey to the summit of Snaefell. A descending car ran into two stationary cars, telescoping them, and sending them along the line some 50 yards. All three cars were badly damaged.

TELEGRAPH AND TELEPHONE NOTES.

Channel Islands.—The Channel Islands cable was repaired last week, but again broke down. The telegraph steamer *Electra*, which was returning to London after repairing the previous break, was stopped at Dover, and returned to the Channel Isles.

Chicago.—The City electrician is urging the installation of a municipal system of telephones for the use of the city departments. About 1,400 instruments would be needed.

Durban.—The reported refusal by the Government of the Marconi Telegraph Co.'s offer to establish a station locally has been confirmed. No reason is given, but probably (says a correspondent) the Government fears interference with the revenue from its present telegraph system, the Marconi Co. having proposed to take half the receipts for messages received or dispatched from its station for inland service.

Melbourne-Sydney. — The Postmaster-General, Mr. Austin Chapman, has decided to place on the Estimates a sum for the construction of a telephone trunk line between Melbourne and Sydney, of such strength and durability that, if extensions to Adelaide and Brisbane should hereafter be decided on, it will stand the increased traffic. The proportion of the cost of the work, rightly debited to the telephone service, is about £30,000. Use will be made of the existing telegraph posts over a good portion of the route.

Telegraphic Interruptions and Repairs :—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara (No. 1)	Aug. 26, 1901	
Dominica-Martinique	May 7, 1902	
St. Lucia-Martinique	May 7, 1902	
Cayenne-Pinheiro	Aug. 13, 1902	
Reissa-Issa (Yemen) Camaran	Oct. 22, 1902	
Tarifa-Tangier	Jan. 18, 1904	
Closed Vladivostock-Nagasaki	Feb. 9, 1904	
Closed Port Arthur-Chifu	Mar. 9, 1904	
Jamaica-Colon	Jan. 5, 1905	
Cadiz-Tenerif	July 20, 1905	
England-Guernsey	Sept. 6, 1905	Sept. 15
Landlines.		
Puerto-Barrios	July 28, 1902	
Kertch-Soutehoum	Sept. 27, 1904	
Alaska landlines	Aug. 27, 1905	
Communication with Brazil *via* Galveston	July 18, 1905	

Venezuela.—President Castro has decided to prorogue the execution of the decree recently pronounced by the Venezuelan Courts, cancelling the contract between the Venezuelan Government and the French Cable Co., in order to permit of negotiations.

West Africa.—The Southern Nigerian Government has announced that the telegraph line has been extended to Benin city, Sapeli, and Warri, and that offices for the reception of messages have now been opened at the places named. The charge is 2d. per word above the telegram price to Bonny, the Nigerian Government undertaking the redistribution.

Wireless Telegraphy.—The Constantinople correspondent of the *Daily Mail* states that the Sultan is greatly opposed to the introduction of wireless telegraphy. The apparently mysterious workings of the apparatus affrighted his Majesty, and he dismissed the matter as an invention of the evil one, and gave strict instructions that it should never be brought before him again.

The Government of British Guiana is calling for tenders for the establishment of a wireless telegraph service between Georgetown, Demerara, and the Isle of Barbados, a distance of 470 miles over sea. From a recent issue of the *Argosy*, of Demerara, we learn that the Government first approached the West India and Panama Telegraph Co., and asked whether the company would lay a new cable to British Guiana in the event of the Government restoring to it for a period of 10 years the special subsidy of £1,500 a year, which was granted when the special cable was laid, and withdrawn on April 1st last. The company replied in the negative.

On September 7th a new Marconi station was opened at Sable Island, 90 miles south-east of Cape Canso, Nova Scotia.

CONTRACTS OPEN AND CLOSED.

OPEN.

Bermondsey.—The borough surveyor has been instructed to prepare specifications and invite tenders for the wiring of St. John's Girls' School.

Bishop Stortford.—September 26th. The U.D.C. is inviting tenders for lighting such of the public streets as are at present lighted, for two or three years from September 30th, 1905. Thomas Swatheridge, Clerk of the Council.

Burton-upon-Trent.—September 25th. Feeder cables, conduits, &c., for the Corporation tramways. See "Official Notices" September 8th.

Chiswick.—September 29th. Wiring refuse destructor and other buildings for the U.D.C. See "Official Notices" September 15th.

East Indian Railway.—September 27th. The E.I.R. Co. is inviting tenders for the supply and delivery of electric plant and materials, as per specification, to be seen at the company's offices, Nicholas Lane, London, E.C. For each specification a fee of £1 1s. is charged, which cannot be returned.

France.—September 26th. The French Post and Telegraph Authorities in Paris are inviting tenders until the 26th inst. for the supply of 216 kilometres of submarine cable core, 50 tons of iron wire, 2½ mm. diameter; 10 tons ditto, 5 mm. diameter; 350 tons ditto, 7 mm. diameter, and 100 tons ditto, 8 mm diameter. Particulars may be obtained from, and tenders are to be sent to, Le Sous-Secretariat d'Etat des Postes et des Telegraphes, 103, Rue de Grenelle, Paris.

London.—October 3rd. Low-tension and extra high-tension cables for the L.C.C. See "Official Notices" September 15th.

London.—September 29th. Thirty-four tramcar bodies, trucks, equipments, &c., for the L.C.C. See "Official Notices" September 1st.

Manchester.—September 27th. Tenders are invited for the electrical installation of the new chief fire station and police station, London Road, Fairfield Street and Whitworth Street, Manchester. Specification, &c., at the City Treasurer's office, Town Hall, Manchester, on a deposit of three guineas.

Mussoorie (India).—October 23rd. Supply and erection of steel power pipes, water motors, alternators with exciters, switchboards complete, transformers, induction motors, pumps, workshop machines; also bare copper overhead mains, insulators, and lightning arresters, arc and incandescent lamps, telephone equipment, workshop tools and general stores. See "Official Notices" July 14th.

Pembroke.—September 22nd. Mains, arc lamps and pillars, meters and switchboard panels, for the U.D.C. See "Official Notices" August 25th.

Pontypridd.—September 30th. Cables and overhead equipment for U.D.C. tramways. See "Official Notices" September 8th.

Spain.—October 14th. The Spanish Ministry of Public Works in Madrid is inviting tenders until October 14th for the concession for the construction and working of an electric tramway in Saragossa. Particulars may be obtained from, and tenders are to be sent to, El Ministerie de Obras Publicas, Madrid.

Wemyss.—September 27th. Permanent way for tramways. See "Official Notices" September 15th.

CLOSED.

Burslem.—The T.C. has accepted the tender of Mr. E. M. Evans for wiring the Institute for the E.L., at £66, and that of Messrs. Dick, Kerr & Co., Ltd., for a 200-kw. engine and dynamo.

Camberwell.—The Guardians reported on Monday having decided to place their orders for electrical fittings during the forthcoming 12 months with the following firms:—

Bell's Asbestos Co., Ltd.
General Electric Co., Ltd.
Reed's Electrical & Engineering Supply Co., Ltd., and
H. W. Willcox & Co.

Croydon.—The Corporation has accepted the tender of Messrs. T. Harding Churton & Co. for the supply of single-phase induction motors and centrifugal pumps.

Grimsby.—The T.C. accepted the tender of Messrs. A. C. Dickins & Co. for lighting the Highways Yard by electricity, at £68 14s.

Mansfield.—The T.C. has accepted the tender of Mr. Bertram Thomas for the supply of two time-limit circuit-breakers for the electricity works, at £32 10s.

Neath.—The R.D.C. has affixed its seal to a number of documents in connection with the electric lighting undertaking, including contracts with Callender's Cable and Construction Co., at £8,449 17s., and Messrs. Johnson & Phillips, at £9,335 17s. 9d.

Ramsgate.—The T.C. has accepted the tender of Mr. E. G. Philpott for an installation of firemen's electric call bells, at £77 16s., with a maintenance fee of £4 10s. per annum for seven years.

Taunton.—The T.C. has accepted the tender of Messrs. Babcock & Wilcox, Ltd., for the supply of a boiler (fitted with superheater and economiser) and pipe-work for the electricity works, at £1,460.

West Ham.—The B.G. has accepted the tender of Messrs. Troup, Curtis & Co., of Victoria Dock Road, Custom House, for the ensuing year's supply of electrical fittings.

FORTHCOMING EVENT.

Monday, September 25th.—Opening of the Electrical Exhibition at Olympia.

THE ELECTRICAL ENGINEERS R.E. (VOLS.).

Guard of Honour.

The Corps furnishes Guard of Honour at 1 p.m. at Olympia for opening of the Electrical Exhibition on Monday, 25th inst.

The O.C. wishes that members of the Corps attending this Exhibition at any time will do so in uniform, and he will try to obtain special rates or passes for those who do so.

(Signed) Wilfrid C. Dumble, Capt., R.E.
Adjutant.

NOTES.

Testing Rubber Gloves.—The following interesting letter has come to hand just in time for insertion:—"With reference to your leading article in last week's Review on 'Accidents Due to Electrical Shock,' it may be of interest to some of your readers for me to say that in testing rubber gloves I have found by inflating them with air, and then putting them under water, I have discovered *very* many small holes in new ones which would otherwise have been impossible to find.

"Quite recently I had to reject 24 per cent. out of a batch of new ones.—Gloves."

The Fulham Baths Arbitration.—In regard to the arbitration, under the electric lighting contract for the baths, relative to the question of damages claimed by the Council from the contractors, the National Electric Construction Co., for reimbursement of the costs and damages paid by the Council in respect of the two fatal accidents in December, 1902, the town clerk says that the award may be made within a month or so, and will probably be in the form of a special case, finding certain facts and stating questions of law for the opinion of the K.B. Division of the High Court.

A Turbine Locomotive.—According to the *Daily Telegraph*, Mr. Hugh Reid, the managing director of the North British Locomotive Co., has patented a self-contained electric locomotive in the form of a miniature central station on wheels which will generate its own current by means of a boiler and a condensing Parsons turbine; it is somewhat on the plan of Heilmann's experiment, with the difference that the latter used Willans high-speed engines in the place of a turbine. In addition, Mr. Reid proposes to uses an air-cooled condenser of somewhat novel design.

Will.—According to the *Times*, Mr. William Bruce Dick, who died on July 11th, aged 75, founder of the firm of Dick, Kerr & Co., left estate valued at £233,349 gross in the United Kingdom, of which £157,979 is net personalty.

An Electrically Equipped Colliery.—The programme of the Institute of Mining Engineers, which met in Manchester last week, included a visit to the Douglas Bank Collieries, near Wigan, for the purpose, mainly, of inspecting the extensive electrical equipment which has been installed there. There are two shafts, each 2,071 ft. deep. Ten boilers—five at each pit—connected by steam pipes, provide power for winding and ventilation, but for haulage and pumping the motive power is electricity. The plant, in a separate building, consists of two sets, each of 250 B.H.P. when worked condensing. The condensing plant has not yet been erected, but the plans are completed. There are two enclosed inverted vertical compound Belliss & Morcom engines, with two cylinders, and forced lubrication to all the bearings. The three-phase Brown-Boveri generators are direct coupled to the engine shafts. The exciters are also driven by the same shafts. The speed of the engine is 400 r.p.m. The current has a pressure of 550 volts and a periodicity of 40. Current from these two units is used for driving the underground motors, and a 2-B.H.P. motor on the surface, which pumps the safety lamp oil into a service tank erected above the turning shop at the end of the lamp rooms by means of a small three-throw horizontal pump. The same current drives, when required, a small wood-turning lathe, and lights the pit eyes, shaft sidings and motor-houses and adjacent roads below ground. During coal-winding hours the current is also used for lighting the screens. All lighting is effected through transformers, which reduce the pressure from 550 to 230 volts. By means of change-over switches the screens are lighted, when the continuous plant is running, by means of the continuous current from the 45-B.H.P. plant situated in the fan-house. This dynamo is driven by a Ruston-Proctor vertical engine by means of a leather chain belt. The dynamo is wound for 230 volts, and the current is used for all arc lamps on the surface, and for lighting the offices and workshops and screens when required, also for driving the lamp-cleaning machine motor of $\frac{3}{4}$ B.H.P., and the "booster" for charging the safety lamp lighting batteries. The cables from the three-phase plant switchboard to the shaft bottoms are enclosed in "Haskinised" wood casing. The power cables below ground are all three-core steel-tape armoured, and are suspended by leather thongs behind the bar-legs. Eight seams of coal are now being worked to the four pit-eyes, and all are worked on the long-wall principle. No coal-cutters are as yet at work, but a three-phase diamond overhead coal-cutter of 30 B.H.P. is in course of construction. It will cut in the Hoo Canel on the top in the Pemberton 2 ft. mine, to a depth of 4½ ft. The machine is expected to be at work next month, and if successful, other similar cutters will be introduced. A Grant electrically-driven rock drill is used for drilling the holes in a tunnel that is being driven through the measures, rising one in three. It is driven by a three-phase Brown-Boveri motor of 5½ B.H.P. The endless-rope haulage, on the overhead system, is driven by three-phase electric motors; four of 50 B.H.P., and four of 25 B.H.P. The motors are of the Brown-Boveri slip ring type, working at a pressure of 500 to 550 volts. Each motor starts against the load, by means of a main switch and a liquid starter. The 50-H.P. motors run at 600 r.p.m., and the 25-H.P. motors at 800 r.p.m. The rope speed in all cases is at the rate of 2 miles per hour. Reduction in speed is obtained by means of gearing, the rope pulleys being on the fourth-motion shaft. The two pumps are below ground, electrically driven, and are of 5 B.H.P., each lifting 50 gallons of water per minute against a head of 130 ft. The Brown-Boveri motors for these pumps, of the squirrel-cage type, work at a speed of 1,200 r.p.m. at a pressure of 500 volts. The pumps are of the three-throw vertical Smith-Vaile type. Preparations are being made, and will soon be completed, for the erection of two electrically-driven shaft pumps of 15 B.H.P. The motors will be of the same type as the haulage motors. The pumps will be of the three-throw horizontal type, 4 in. in diameter × 6 in. stroke. The vertical lifts will be 381 ft. and 570 ft. respectively.

Electric Hauling Gear at Dover.—According to the *Morning Post*, in order to render the National Harbour at Dover torpedo-proof, powerful electric hauling gear is being arranged at the ends of the breakwaters, so as to stretch heavy wire hawsers across the entrances.

Tramcar and Motor-Car.—James Chilcott, motor engineer, on Tuesday obtained a verdict for forty guineas damages and costs against the Metropolitan Electric Tramways, Ltd., for injuries received in a collision of one of the company's electric cars with a motor-car in which plaintiff was seated at the time. The motor-car seems to have suddenly come to a standstill a few yards in front of the tramcar.

Appointments Vacant.—Demonstrator in electrical engineering for Manchester Municipal School of Technology (£120); charge engineer for Willesden U.D.C. sub-station (35s.); assistant engineer for Edinburgh electricity department (£180, rising to £270); instructor in mathematics for the Northampton Institute (£120); working superintendent for Maidstone (£90); assistant head master for Cork Municipal Technical Institute (£200).

Charge of Embezzlement.—Mr. J. W. Endean, who resigned the position of manager and engineer of the Devonport and District Tramway Co. on Saturday, was arrested on Tuesday on a warrant charging him with embezzlement. He had been manager of the company for the past five years.

Gift to Magee College.—The *Times* says that Mr. Bazil McCrea, a Belfast railway contractor, has given £6,000 to found a chair of experimental physics in Magee College, Londonderry, and to provide two scholarships in connection therewith.

Electric Commercial Wagons in America.—The *Automobile Builder*, of America, estimates that the number of electric commercial wagons now in actual service in that country can be conservatively placed at 4,000.

The Question of Overtime.—At Nottingham, on Tuesday, a meeting of the Amalgamated Society of Engineers was held to consider rules relating to overtime, an arrangement which has hitherto obtained in regard to this matter having been found impracticable. It was decided to delete the rule to which exception was taken, but at the same time to adopt early measures to secure more stringent limitations of overtime than is now generally observed, and to accomplish this by an arrangement with the Engineers' Employers' Federation, thus making the matter generally binding, and not leaving it to mere sectional control.—*Times.*

OUR PERSONAL COLUMN.

[*The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.*]

Central Station Engineers.—The Mansfield T.C. on Friday decided to increase the salary of Mr. SANKEY, assistant electrical engineer, from £140 to £156 per annum. It has been suggested that he shall be relieved of some of his duties and go round the town canvassing for consumers.

The Electricity Committee of the Burnley T.C. has appointed Mr. JAS. E. STARKIE, first assistant engineer at the electricity works, as borough electrical engineer, at a salary of £250 per annum, rising to £300 a year hence.

Mr. H. G. ANDREWS has been appointed assistant to Mr. J. BULFIN, borough electrical engineer of Bournemouth, *vice* Mr. F. Roose, who recently resigned to join the London County Council.

On Saturday, the 16th, at Palace Gardens Church, Kensington, the marriage took place of Mr. A. B. CHILD, chief engineer and manager of the St. Austell's power station, Cornwall, with Miss Jessie Blackburn. The Rev. Thomas Child, father of the bridegroom officiated.

Mr. CUTHBERT M. MOORE, late electrical engineer at East London, Natal, was presented with a purse of sovereigns from the municipal and electrical staffs, on the occasion of his leaving the town. The Mayor, in making the presentation, bore testimony to Mr. Moore's conscientious work in the town, and voiced the general regret that was felt at his departure.

The Electricity and Tramways Committee of Swindon T.C. has recommended that the salary of Mr. J. G. GRIFFIN, electrical engineer, be increased from £300 to £325 per annum.

The Greenock Corporation has appointed Mr. W. A. TOPPIN as superintendent of the meter and installation department, at a salary of £130 per annum.

Mr. P. A. LOCKE, senior chargeman at Plymouth Corporation electricity works, has been appointed chief lecturer in electricity under the Education Authority of Bolton, Lancs. Mr. Locke has been senior chargeman at Plymouth for five years, and has for some time been lecturer in electricity at the Plymouth Technical Schools.

Mr. F. A. BOND, the chief engineer at Heston and Islesworth U.D.C. electricity works, is to be married on October 12th next to Miss Jessie Berry, second daughter of Samuel Berry, Esq., ex-Mayor of Barnstaple, where the wedding will take place.

The Colwyn Bay D.C. has increased the salary of its electrical engineer by £20 to £200 in consideration of his undertaking all extensions of plant and mains. The cost of the extensions is to be £17,000.

Tramway Officials.—Mr. FRED. SCHOFIELD was on September 13th presented, at a complimentary dinner, with a silver cigarette case on his departure from Bradford, where he has acted as tramway traffic manager, to take up the position of tramways manager at Leyton.

General.—Mr. JOHN B. C. KERSHAW, of Waterloo, Liverpool, was married on 12th inst., at Handforth, Cheshire, to Edith Milman, only daughter of George Gething, of Parkfield, Styal.

Mr. J. E. Sayers has assumed Mr. JAMES CALDWELL, formerly his assistant, as partner in the business, as from August 20th. The new firm will practise as consulting engineers and electricians, at 157, West George Street, Glasgow, under the name of J. E. Sayers and Caldwell.

Indian Engineering reports that Mr. R. P. RUSSELL, whose appointment as electrical inspector for the United Provinces was sanctioned by the Secretary of State for India, took up his appointment at Allahabad on July 20th. His headquarters will be at Allahabad.

LORD BALFOUR OF BURLEIGH, K.T., has been elected to a seat on the board of the Western Telegraph Co., Ltd., in the place of Mr. W. S. Andrews, resigned.

The *Standard* says that Mr. H. WILSON FOX, of the British South Africa Co., and Mr. W. A. WILLS have returned to England from their visit to the Niagara Falls, whither they went some little time ago to study the method of electrical transmission there, with a view to its adoption at the Victoria Falls in Rhodesia.

Obituary.—Mr. WILLIAM FOWLER, chairman of John Fowler & Co., Ltd., Leeds, died on Saturday at Folkestone in his 78th year.

ELECTRIC TRAMWAY ACCOUNTS.

Salford Municipal Tramways.

We give herewith the returns of the Salford tramway undertaking for the 12 months ending March 31st last. During that period the department much improved its position financially; the average earnings were on the upgrade, and working expenses showed a considerable reduction both in total and per car-mile. The surplus after meeting all expenses (working, financial and rentals) averaged out at 1d. per car-mile as compared with ¾d. (roughly) in 1904.

The year witnessed the opening of several new routes, as indicated in our statement; the tramways worked by the Salford department being as follows:—

Salford	36½ miles	Owned by Corporation.
Manchester	9½ „	Running powers by agreement.
Eccles	6½ „	Leased to Corporation.
Swinton and Pendlebury	6¾ „	„ „
Prestwich	7 „	„ „
Whitfield	4½ „	„ „
Total	70¾ miles	

Of the 6,927,805 units used on the tramways, 1,002,677 were supplied by the Manchester Corporation at 1·4d. per unit, the remainder being purchased from the Salford E.L. Department at 1·5d. per unit.

GENERAL STATEMENT.

For 12 months ending March 31st	1905.	1904.
Length of route	38¾ miles.	32 miles.
Total length of track	70¾ „	59½ „
Average number of cars in use ...	117	—
Car-miles run	4,884,590	4,726,466
Passengers carried per annum... ...	39,213,560	36,956,405
Capital expended to date	£638,332	£620,069
Traffic receipts	£209,656	£198,422
Total receipts	£209,672	£198,890
Working expenses	£134,892	£138,541
Gross profit	£74,780	£60,349
Income per car-mile	10·30d.	10·09d.
Working expenses per car-mile ...	6·62d.	7·03d.
Interest and sinking fund per car-mile	1·87d.	1·73d.
Rental of leased lines...	·79d.	·55d.
Total expenses per car-mile	9·28d.	9·31d.
Profit or loss per car-mile	+1·02d.	+·78d.
Cost of energy per car-mile	2·10d.	2·42d.
Average fare per passenger	1·28d.	1·2d.
„ „ charged per mile ...	·59d.	—
Revenue per mile of route	£5,376	£6,215
Expenditure per mile of route ...	£3,458	£4,330
Total units used...	6,927,805	6,102,524
Units used per car-mile	1·41	1·29
Percentage of working ex'es to receipts	64%	69·5%

PROFIT STATEMENT, 1904-5.

Interest and sinking fund charges ...	£38,106
Rental (leased lines, running powers, &c.)	16,168
Contribution in relief of rates... ...	13,000
Depreciation and renewals fund ...	8,935
Gross profit and accumulated interest	£76,209

The year's working produced a gross profit of £74,780, which was further swollen to £76,209 by interest on investments; after meeting the absolutely necessary payments and providing the ratepayers' "annual bonus" (this year amounting to £13,000), the balance of £9,000 went to swell the depreciation and renewals fund, which totals some £21,000.

Mr. Ernest Hatton, who occupied the position of general manager during the period under review, has taken up a similar position at Newcastle-on-Tyne, his successor being Mr. G. W. Holford.

CITY NOTES.

Mexico Electric Tramways, Ltd.

The report for 1904 shows a net balance to credit of profit and loss account of £53,897, which, added to the balance brought forward from last year of £5,728, gives the total sum of £59,625. Out of this the usual dividend of 6 per cent. has been paid on the preference shares, amounting to £30,000, and a depreciation reserve account has been credited with the sum of £15,000, leaving a balance of £14,625 to be carried forward. During the year the La Piedad Mule line was reconstructed and opened to electric traction on May 30th, 1904, and also during that year the reconstruction work to electric traction was commenced both on the Tacuba and Atzcapotzalco line, and also on the Peralvillo New Rastro Mule line. To meet the requirements of these new lines and the traffic generally, 28 new passenger cars were added to the company's equipment; in addition to these, four new express cars, 12 express wagons and 25 freight cars were also added to the service. The number of passengers carried was 42,602,194, an increase of 6,123,610, while the gross receipts, $3,272,307, show an improvement of $473,024. In March, 1904, Mr. Charles Clegg resigned his position as general manager of the company in Mexico, and Mr. W. W. Wheatley, of New York, was appointed general manager in his place.

Dick, Kerr & Co.

The report for the year ended June 30th shows that profits amounted to £85,007, while £39,922 was brought forward, the disposable balance being £110,076. The directors recommend a dividend of 10 per cent. on the ordinary capital. The sum of £23,388 is carried to a special reserve for extensions of manufactories and replacements and depreciation of machinery, leaving £42,387 to be carried forward. The directors state that during the past year the company has been fully employed on contracts both at home and abroad, and the manufacturing departments have been kept busy. The prospects for the current year are encouraging, although attention is drawn to the severe competition which exists in all branches of the business.

Halifax and Bermudas Cable Co.—The directors, in their report for the year ended June 30th, recommend a final dividend of 2½ per cent., making with the interim dividend paid 5 per cent. for the year, and leaving £198 to carry forward.

Stock Exchange Notices.—The Committee have ordered the undermentioned securities to be quoted in the Official List:—

Folkestone Electricity Supply Co., Ltd.—Further issue of £25,000 4½ per cent. first debenture stock.
Marconi's Wireless Telegraph Co., Ltd.—251,127 shares of £1 each, fully paid, Nos. 1 to 251,127.
South Staffordshire Mond Gas (Power and Heating) Co.—33,346 ordinary shares of £10 each, fully paid, Nos. 1 to 3,334 and 4,001 to 34,012.

Direct Spanish Telegraph Co.—The board have decided to pay in addition to the dividend at the rate of 10 per cent. per annum on the preference shares, an interim dividend at the rate of 4 per cent. per annum, free of income-tax, on the ordinary shares, both for the half-year ended June 30th, 1905, and payable on October 2nd, 1905.

Rosario Electric Co.—The directors have declared a final dividend of 3s. per share on the 12,000 preference shares of the original issue, making, with the dividend already paid, 6 per cent. for the year ended June 30th last, and of 9·23d. per share on the 8,000 new preference shares, being the equivalent of 6 per cent. per annum from the dates of the respective calls to June 30th last.

Armstrong, Whitworth & Co.—The directors recommend a final dividend of 10 per cent., making with the interim dividend, a distribution of 15 per cent. for the year, carrying forward upwards of £84,000, or about £2,000 less than last year.

STOCKS AND SHARES.

Wednesday evening.

Money and foreign politics are the predominant factors in Stock Exchange prices this week. Neither of them made for better prices, and a sharp shake-out in the Kaffir gambles left its trace upon other markets round the House. But electrical stocks and shares maintain their even plane of steadiness, and the only sensation of the week is furnished by the speculative Anglo-American Telegraph trio. There is a generally better tone to record, and a noticeable movement is a good recovery in British Electric Traction Ordinary shares.

Electric Railway stocks are a little firmer where any change has occurred, but the semi-steam issues are decidedly weak. Central London Deferred rose a point to 79½. Districts, however, dropped to 34½ and Metropolitans to 90½, in sympathy with the flatness of Home Rails as a whole. Charing Cross 4 per cent. scrip certificates are 75, and Great Northerns ½ per cent. more. Great Northern and City Preferred continue to be quoted at 5¼ middle.

Several rises occurred in the traction department. British Electric Ordinary are as much as £1 better at 9½, and those who ought to know say that the recently-introduced economies are beginning to tell. Moreover, the company appears to be emerging from some of its troubles. Argentine Tramway Ordinary are still 8⅝, but there has been a smart rise in Belgrano Ordinary, which are now 4¼, an improvement of 22s. 6d. from the recent lowest price. The talk of a probable competitive line running parallel with the Belgrano or the Anglo-Argentine system is now laughed at, but it had a pronounced effect upon the prices of both companies' shares, and the market is sensitive to fears of what may even yet occur. So far as we are able to judge by the result of careful inquiry, there is no reason whatever to suppose that the Argentine Government would grant concessions practically neutralising those already given to the existing tramway undertakings, but the South American mind works differently from that to which we are accustomed. Buenos Ayres Grand National 5½ per cent. Preference Debentures are 102½, and City of Buenos Ayres (1904) shares are 5⅝ *ex* dividend. Calcutta Trams at 9¾ and 9 for old and new Ordinary respectively are not altered. The Debenture stock is quoted at 107-109, but a holder got 108½ the other day, so scanty is the supply in the market. Metropolitan Electric Debenture has risen to 106½, and there was a little business done in Potteries last Tuesday, the Ordinary changing hands at 8¾, and the Preference at 9 15/16. Cape Tramways are talked better than their present price of 30s., and Lisbon Trams command a small market at about 27s. Those interested in mechanical traction may observe that Road Car shares have reached 6½, a rise of the fraction within a few months.

By its present issue of 1,500 shares at 5, the little Oxford Electric Company places its full authorised share capital in the hands of its proprietors. The existing shares are 6¾, *ex* the dividend of 2s. 6d. just paid, so that there is a fair bonus for the allottees. In the Metropolitan list, Chelseas are nominally down about 7s. 6d., allowing for the dividend, but the real fall is less than would appear from the quotation. County of Londons advanced ⅛, and St. James's ¼, all the best shares being in demand. When the Administrative scare was at its height, a few shrewd buyers sent in to secure whatever cheap shares might be offered. They bought a respectable number more than the market did, and the consequence is that some of those purchasers have not received all their transfers yet. Debenture stocks display their usual hardening tone, despite the probable advent of dearer money.

Several manufacturing shares are firmer, noticeably Crompton's and British Insulated. The former shares rose ⅛ to 1⅝, and the Debentures regained their point loss of last week. British Insulated, *ex* a 4s. dividend, are unchanged in price at 6. Westinghouse Preference at 2½, and the Debentures at 87 remain quiet.

Reference has been made to the jump in Anglo-American Telegraphs, of which the Ordinary stock is 2 per cent. up, the Preferred 1½ and the Deferred 1⅝. The speculation in the last-named is enormous, forcing the price to 17¼. Buyers are supposed to regard the stock as cheap in comparison with some of the non-dividend paying issues of other markets, but since nothing was paid for 1904, 2s. per cent. for 1903, and 1s. per cent. for the previous twelvemonth, to speak of these as "divds" looks like a poor jest at the stockholders. Something, of course, may fall to the latter next February, but in the meantime the company has to make up the full 6 per cent. on the Preferred, the amounts paid being short of the proper sum up to the present. But there is, of course, the reserve fund in favour of the Deferred. Except for this sensation, Telegraphs have had a quiet week. Western shares at 14¼ are 5s. up, and so are the Second Preference of West India and Panama at 7¼. Great Northerns rose ¼, to 35½. Direct United States are ⅛ up, at 12⅛. Marconi keep about 7 5/16.

Telephones exhibit little of interest. National Preferred rose 1½, to 113, and vague estimates of what the stock may be repaid at now range from 105 upwards. Chili Telephones put on ⅛, to 7⅝, but there is no move either in Monte Video or Oriental shares. At 102½ Telephone of Egypt 4½ per cent. Debenture stock is practically unaltered.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last four years. 1902.	1903.	1904.	1905.§	Closing Quotations Sept. 13th.	Closing Quotations Sept. 20th.	Business done week ended Sept. 20th, 1905. Highest	Lowest.	Rise + or Fall —
34,800	African Direct Telegraph, 4 % Debs...	100	4 %	4 %	4 %	..	99 —102	99—102	..	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	3 — 3⅛	3 - 3⅛	3 7/16	3⅛	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	Nil	..	82 — 87	82 — 87	84	..	..
763,580	Anglo-American Telegraph	Stock	60/6	61s.	2½%	29s.§	59 — 61	61 — 63	63	62	+2
3,118,210	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6¼%	58s.§	106 —107	107½—108½	108½	106½	+1½
3,118,210	Do. do. do. Deferred	Stock	1/-	2s.	Nil	..	15⅜ — 16	17⅜— 17⅝	17⅝	15 11/16	+1⅝
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	7 %	8 %	..	7⅞ — 7⅞	7⅞ — 7⅞	7 15/16	7⅞	+ ⅛
1,932,856£	Commercial Cable Stlng. 500 year 4 % Deb. Sk. Red.	Stock	4 %	4 %	4 %	..	97 — 99	97 — 99	99	96⅜	..
16,000	Cuba Telegraph	10	6½%	10 %	5 %	..	9 — 9¼	9 — 9¼	9 1/16	..	..
6,000	Do. 10 % Pref.	10	10 %	5 %	10 %	..	17½ — 18½	17½ — 18½	..	..	..
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	..	3⅜ — 3⅝	3⅜ — 3⅝	..	..	..
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	..	9¼ — 9⅝	9¼ — 9⅝	..	..	..
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	..	100 —103	100 —103	..	..	..
60,710£	Direct United States Cable	20	3½%	5 %	5½%	..	11⅝ — 12⅛	12 — 12¼	11 13/16	..	+⅛
74,500	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	..	100 —102	100 —102	..	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	..	144½—147½	144½—147½	147	145	..
2,000,000	Do. 3½ % Pref. Stock	100	3½%	3½%	3½%	..	90 — 92	90 — 92	91½	91⅜	..
1,836,814	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	..	108 —110	108 —110	..	..	..
300,000	Eastern Extension, Australiasia, and China Tele.	10	7 %	7 %	7 %	..	13⅜ — 14½	13⅜ — 14½	14 3/16	13 15/16	..
602,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	..	106 —108	106 —108	107⅜	..	..
300,000	East & S. Afric. Tel., 4 % Mt. Db., 1 to 3,000, red. 1909	100	4 %	4 %	4 %	..	99½—101½	99½—101½	..	..	..
200,000£	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	..	101½—103¼%	101½—103½	..	..	..
180,887	Globe Telegraph and Trust	10	£3 16 7*	5½%	5⅜%	..	10⅜ — 11	10⅜ — 11	10 11/16	10⅜	..
180,887	Do. do. 6 % Pref.	10	6 %	6 %	6 %	..	14⅜ — 14⅝	14⅜ — 14⅝	14 1/16	..	..
150,000	Great Northern Telegraph, of Copenhagen ..	10	12½%	15 %	24 %	..	34½ — 35½	35 — 36	35⅝	34½	+ ½
46,500	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	..	100 —102	100 —102	..	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	13 %	..	52½— 54½	52½— 54½	..	..	..
72,680	Monte Video Telephone Co., Ltd. Ord.	1	3 %	3 %	..	..	⅜— ½	⅜— ½	..	..	..
1,983,333	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %§	111 —112	112½—113½	113	111⅜	+1⅛
1,966,667	Do. do. Def. Stock	100	4½%	5 %	5 %	5 %§	107¼—108¼	107½—109½	108⅜	107⅛	+ ½
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %§	13¼ — 14½	13¼ — 14½	14⅜	13⅜	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %§	12 — 13	12 — 13	12⅜	..	..
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %§	5⅜ — 5¾	5⅜ — 5¾	5⅝	5 3/8	..
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	..	99½—101½	99¼—101¼	100⅛	99½	..
1,689,593	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	..	104 —106	104½—106½	..	..	+ ½
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid	1	6 %	6¼%	6¼%	..	1 1/16 — 1 1/8	1 1/16 — 1 1/8	1 1/16	..	..
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	..	1 1/16 — 1 1/8	1 1/16 — 1 1/16	..	..	..
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	..	100 —103	100 —103	..	..	..
11,839£	Reuter's	8	5 %	5 %	5 %	..	7½ — 8½	8 — 8½	..	..	+ ½
3,237	Submarine Cables Trust	Cert.	6 %	6 %	6 %	..	127 —130	127—130	..	..	..
58,000	United River Plate Telephone	5	7 %	8 %	8 %	..	7 — 7⅜	7 — 7⅜	..	..	..
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	..	5¼ — 5⅝	5¼ — 5⅝	..	..	..
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	..	109½—111½	109½—111½	..	..	..
15,609£	West African Telegraph, Shares	10	2 %	4 %	4½%	..	10 — 10⅛	10 — 10⅛	..	..	..
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2½	Nil	Nil	Nil	..	1/16— 1/8	1/16— 1/16	..	..	..
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	..	100 —102	100 —102	..	..	..
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930 ..	10	7 %	7 %	7 %	..	13⅜— 14½	14 — 14⅜	14 5/16	14⅛	+ ⅛
75,000	Do. do. 5 % Debs. 2nd series, 1906	100	5 %	5 %	5 %	..	101 —103	101 —103	..	..	..
563,380	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	..	102½—104½	102½—104½	104	100½	..
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	..	1/16— 1/8	1/16— 1/8	..	..	..
34,563	Do. do. 6 % Cum. 1st Pref.	10	7 %	7 %	6 %	..	8¾— 9	8¾— 9	..	..	..
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	..	6½— 7⅛	7 — 7⅛	..	..	+ ⅛
80,000£	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	..	101 —104	101 —104	102⅛	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

40,000	British Aluminium 7 % Cum. Pref.	5	Nil	Nil	Nil	..	4⅜— 5⅛	4⅜— 5⅛	..	..	..
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	Nil	Nil	..	4⅜— 5⅛	4⅜— 5⅛	4 13/16	..	..
20,000	Do. do. 4 % Funding Certs.	5	..	..	..	..	2¾— 3¼	2¾— 3¼	..	..	..
300,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	..	99 —103	99 —103	..	..	..
133,301	British Electric Traction	10	8 %	6 %	6 %	..	8½— 8⅞	9¼— 9⅝	9 5/16	8⅞	+⅛
156,437	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	..	10½— 11	10½— 11	10⅝	10 5/16	..
1,000,000£	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	..	123 —125	123 —125	124⅜	123⅛	..
250,000	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	..	4½%	..	98 —100	99 — 101	99¾	99½	+1
100,000	British Insulated and Helsby Cables	5	10 %	8 %	8 %	8 %§	5⅞— 6¼	5⅞— 6¼	..	..	..
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %§	5⅞— 6¼	5⅞— 6¼	..	..	..
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%§	103 —106	103 —106	..	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	⅝— 11/16	⅝— 11/16	..	..	..
50,000	¶ Do. do. 6 % Cum. Pref. ..	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	Nil	..	⅜— ⅝	⅜— ⅝	..	..	..
150,000	Do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	..	1⅛— 1⅜	1⅛— 1⅜	..	..	..
125,000£	Do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	..	91 — 94 xd	91 — 94	93¾	..	..
125,000£	Do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	..	78 — 81	78 — 81	..	..	..
35,000	Callender's Cable Construction shares	5	15 %	12½%	12½%	..	10 — 11	10 — 11	..	..	..
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	5⅝— 5¾	5⅝— 5¾	..	..	..
800,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	..	109 —111	109 —111	..	..	..
1,963,208	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %§	90 — 92	90 — 92	91⅜	91½	..
523,396	Do. do. 4 % Pref. Stock ..	Stock	4 %	4 %	4 %	4 %§	101 —103	101 —103	102¼	101½	..
523,396	Do. do. Def. do.	Stock	4 %	4 %	4 %	..	77 — 80	78 — 81	80	79	+1
1,330,000	City and South London Railway	Stock	3½%	2⅞%	2½%	2 %§	40 — 42	40 — 42	41½	41⅜	..
85,000	Crompton & Co., Nos. 1 to 85,000	3	5 %	2½%	2½%	..	1⅜— 1⅝	1⅜— 1⅞	1½	1 7/16	+ ⅛
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	..	94 — 99%	95 —100 %	..	..	+1
99,261	Edison & Swan Utd., "A" shrs., £3 pd., 1 to 99,261	5	Nil	Nil	..	..	1¼— 1⅜	1⅜— 1⅜	1 5/16	..	..
17,139	Do. "A" shares, 01—017,139 ..	5	Nil	Nil	..	..	2 — 2⅛	2 — 2⅛	2 1/16	..	..
344,023£	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	..	83 — 88	83 — 88	..	..	..
100,000£	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	..	89 — 94	89 — 94	..	..	..
112,100	Electric Construction 1 to 112,100	2	6 %	4 %	Nil	..	⅞— 1⅛	1— 1	⅞	13/16	— ⅛
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	7 %	7 %	7 %	..	1⅛— 2⅛	1⅛— 2⅛	..	..	..
200,000	Do. do. 4 % Perp. 1st Mort. Deb. Sk.	Stock	4 %	4 %	4 %	..	92 — 95	92 — 95	..	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref. ..	10	5 %	5 %	5 %	..	9½— 10	9½— 10	..	..	..
200,000	Do. do. 4 % Mort. Deb. ..	Stock	4 %	4 %	4 %	..	97 —101	97 —101	..	..	..
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	20 %	15 %	15 %	10%§	12 — 13	12 — 13	12⅛	12 1/16	..
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	..	5¼— 5⅝	5¼— 5⅝	..	..	— ⅛
45,900	Do. do. 4½ Mort. Deb. Stock	Stock	4½%	4½%	4½%	..	109 —111	109 —111	..	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works..	10	10 %	10 %	5 %	2½%§	15½— 16½	15½— 16½	15⅝	15⅝	..
300,000£	Do. do. 4% 1st Mort. Deb. ..	100	4 %	4 %	4 %	..	100 —103	100 —103	..	..	..
37,500	†Liverpool Overhead Railway, Ord.	10	1¼%	1⅜%	1½%	..	2⅞— 3	2⅞— 2⅞	..	..	..
10,000	† Do. do. Pref. £10 paid ..	10	5 %	5 %	5 %	5 %§	9 — 9½	9 — 9½	..	..	..
37,350	Telegraph Construction and Maintenance ..	12	20 %	20 %	15 %	..	33½— 35½	33½— 35½	34½	34	..
150,000£	Do. 4 % Deb. Bds., 1 to 1,500 Red. 1909	100	4 %	4 %	4 %	..	102 —104	102 —104	..	..	..
540,000£	Waterloo & City Railway, Ord. Stock	100	3¼%	3¼%	3¼%	3 %§	90 — 92	90 — 92	..	..	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § Interim dividends.
¶ From Manchester Share List.

Bank rate of discount 3 per cent. (September 7th. 1905).

SHARE LIST OF ELECTRICAL COMPANIES *(continued)*.—ELECTRICITY SUPPLY COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years.				Closing Quotations Sept. 13th.	Closing Quotations Sept. 20th.	Business done week ended Sept. 20th, 1905.		Rise + or Fall −
		†	1902.	1903.	1904.	§1905.			Highest	Lowest.	
29,377	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	8 %	10 %	10 %	..	9⅜— 10⅛	9⅜— 10⅛	..	..	..
10,623	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	..	9⅜— 10⅛	9⅜— 10⅛	..	..	..
288,782	Central Electric Supply 4 % Guar. Deb. Stock ..	100	4 %	4 %	4 %	..	103 —106	103 —106	..	..	..
80,000	Charing Cross and Strand Electricity Supply	5	10 %	8 %	8 %	5 %§	6⅞— 7⅛	6⅞— 7⅛	6 13/16	6 13/16	..
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	..	5⅛— 5⅜	5⅛— 5⅜	..	..	..
40,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	..	4⅞— 5	4⅞— 5	4 15/16	..	..
40,000	Do. do. 1903	5	..	4½%	4½%	..	4⅞— 5⅛	4⅞— 5⅛	4 29/32	..	..
350,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	..	103 —105	103 —105	105	..	..
44,436	Chelsea Electricity Supply, Ord.	5	4½%	5½%	6 %	4½%§	6⅛— 6⅜	5⅝— 6⅛ xd	..	..	..
150,000£	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%§	108 —110	108 —110	..	..	..
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	5 %	5 %	6 %	..	11 — 11¼	11 — 11¼	..	..	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	..	13 — 14	13 — 14	..	..	..
400,000£	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	..	123 —127	124 —128	126¾	..	+1
300,000	Do. 4½ % 2nd Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	..	103 —105	104 —106	104¾	..	+1
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4½%	4 %§	8⅛— 9	8⅝— 9⅛	..	..	+ ⅛
30,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	..	12 — 12½	12 — 12½	12½	..	..
400,000£	Do. do. 4½ % Deb. Stock ..	..	4½%	4½%	4½%	..	111 —114	111 —114	113	..	..
250,000	Do. do. 4½ % 2nd Deb. Stock ..	Stock	4½%	4½%	4½%	..	103 —105	103 —105	104	..	..
70,000	Edmundson's Electric Corporation, Ord. Shares ..	5	7 %	7 %	7 %	..	5⅞— 6⅛	5⅞— 6⅛	5 13/16	5 13/16	..
80,000	Do. do. 6 % Cum. Pref. ..	10	6 %	6 %	6 %	..	6⅛— 6⅜	6⅛— 6⅜	6⅜	6 1/16	..
300,000£	Do. do. 4½ % 1st Mort Deb. Stk	100	4½%	4½%	4½%	..	106 —108	106 —108	..	..	..
21,000	Kensington and Knightsbridge Electric Ord. ..	5	10 %	12 %	12 %	..	12 — 12¾	12 — 12¾	..	..	..
136,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	..	97 —100	97 —100	..	..	..
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	Nil	3 %	..	2 — 2¼	2 — 2¼	..	..	..
60,000	Do. do. do. 6 % Pref...	5	6 %	6 %	6 %	..	4⅞— 5⅛	4⅞— 5⅛	..	..	..
371,895	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	..	99 —102	99 —102	..	..	..
100,000	Metropolitan Electric Supply, 1 to 100,000	5	7½%	8¾%	10 %	10%§	10⅞— 11⅛	10⅞— 11⅛	11	10⅞	..
76,121	Do. 4½ % Cum. Pref. 1—71,106, £3 pd.	5	4½%	4½%	4½%	..	5⅛— 5⅜	5⅛— 5⅜	5 13/16	5 13/16	..
220,000£	Do. 4½ % 1st Mort. Deben. Stock ..	..	4½%	4½%	4½%	..	109 —113	109 —113	..	..	..
250,000£	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	..	99 —101	100 —102	..	..	+1
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	..	100 —102%	100 —102%	..	..	..
10,852	Notting Hill Electric Lighting	10	6 %	6 %	7 %	..	14 — 15	14 — 15	14¾	..	..
59,000	Do. do. 4 % 1st Mort. Deb...	100	4 %	4 %	4 %	..	100 —102	100 —102	..	..	..
40,000	St. James' and Pall Mall Electric Light, Ord. ..	5	14½%	14½%	14½%	10%§	13½— 14½	13½— 14¾	..	..	+ ¼
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %§	8 — 9	8 — 9	..	..	..
150,000£	Do. do. 3½ % Deb. Stock Red. ..	100	3½%	3½%	3½%	..	97 — 99	98 —100	..	..	+1
12,000	Smithfield Markets Electric Supply, Ord.	5	2½%	4 %	4 %	..	2¼— 2⅜	2¼— 2⅜	2 9/16	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	..	76 — 80	76 — 80	..	..	..
65,000	South London Electricity Supply, Ord.	5	1½%	3 %	4 %	..	3¾— 4	3¾— 4	..	..	..
100,000	South Met. Elec. Lt. & Power { Ord..	1	Nil	Nil	Nil	..	1/16— 1/8	1/16— 1/8	..	..	..
50,000	*(Late Blackheath and Greenwich* { 7 % Pref... ..	1	Nil	7 %	7 %	..	1 1/16— 1 1/8 xd	1 1/16— 1 1/16	..	..	..
100,000	*Dist. E.L.Co.)* { 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	..	106 —109	106 —109	..	..	..
30,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	..	4⅜— 5	4⅜— 5	4 15/16	4 27/32	..
30,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	5¼— 5⅜	5¼— 5⅜	5 3/32	..	..
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red	100	..	..	4½%	..	105 —107	105 —107	105½	..	..
110,000	Westminster Electric Supply, Ord.	5	12 %	13⅓%	14 %	13%§	12⅜— 13⅛	12⅜— 13⅛	13 1/16	12⅜	..
28,151	Do. do. 5 % Cum. Pref. ..	5	5 %	5 %	5 %	..	6⅜— 6⅝	6⅜— 6⅝	6¼	..	..

Shares not officially quoted :—Mackay Companies, ord., 42—42½. Pref. 76—76½.

† Unless otherwise stated all shares are fully paid. § Interim dividends.

MARKET QUOTATIONS, Wednesday, September 20th.

	CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a	Acid, Hydrochloric	per cwt.	5/-	..
a	,, Nitric	per cwt.	22/-	..
a	,, Oxalic	per cwt.	32/-	..
a	,, Sulphuric	per cwt.	5/6	..
a	Ammoniac, Sal	per cwt.	42/-	..
a	Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a	,, ,, ...	per ton	£30	..
a	Bleaching powder	per ton	£5 10	..
a	Bisulphide of Carbon	per ton	£15	..
a	Borax	per ton	£13	..
a	Benzole (90 %)	per gal.	10d.	..
a	,, (50 %)	per gal.	9½d.	..
a	Copper Sulphate	per ton	£20	..
a	Lead, Nitrate	per ton	£25	..
a	,, White Sugar..	per ton	£31	..
a	,, Peroxide	per ton	£27 10	..
a	Methylated Spirit	per gal.	2/6	..
a	Naphtha, Solvent (90 % at 160° C)	per gal.	5/6	..
a	Potassium Bichromate, in casks	per lb.	3d.	..
a	Potash, Caustic (75/80 %) ..	per ton	£20	..
a	Potassium Cyanide	per lb.	7½d.	..
a	Shellac	per cwt.	190/-	..
a	Sulphate of Magnesia	per ton	£4 10	..
a	Sulphur, Sublimed Flowers ..	per ton	£6 10	..
a	,, Recovered	per ton	£5 10	..
a	,, Lump	per ton	£5	..
a	Soda, Caustic (white 70 %) ..	per ton	£10 15	..
a	,, Crystals	per ton	£3	..
a	Sodium Bichromate, casks ..	per lb.	2½d.	..
a	,, Cyanide	per lb.	7d.	..
	METALS, &c.			
b	Aluminium Ingots, in ton lots ..	per ton	£150	..
b	,, Wire, in ton lots ..	per ton	£177	..
b	,, Sheet, in ton lots ..	per ton	£175	..
b	Babbitt's metal ingots	per ton	£43 to £140	..
c	Brass (rolled metal 2" to 12") basis	per lb.	7¾d.	..
c	,, Tube (brazed)	per lb.	9¼d.	..
c	,, ,, (solid drawn).. ..	per lb.	8¾d.	..
c	,, Wire, basis	per lb.	8d.	..
c	Copper Tubes (brazed)	per lb.	10¾d.	..
c	,, ,, (solid drawn) ..	per lb.	11d.	..
g	Copper Bars (best selected) ..	per ton	£84	..

	METALS, &c. *(continued)*.		Latest Price.	Fortnight's Dec. or Inc.
g	Copper Sheet	per ton	£84	..
g	,, Rod	per ton	£84	..
e	,, (Electrolytic) Bars ..	per ton	£74	..
e	,, ,, Sheets ..	per ton	£87	..
e	,, ,, Rod ..	per ton	£81	..
e	,, ,, H.C. Wire	per lb.	9⅜d.	..
	Ebonite Rod	per lb.	3/3	..
	,, Sheet	per lb.	3/-	..
n	German Silver Wire	per lb.	1/6	..
h	Gutta-percha, fine	per lb.	6/- to 7/-	..
h	India-rubber, Para fine	per lb.	5/7 to 5/7½	..
i	Iron, Charcoal Sheets	per ton	£18	..
i	,, Pig (Cleveland warrants)	per ton	48/5	2d. dec.
i	,, Forgings, according to size	per ton	From £11	..
i	,, Scrap, heavy	per ton	47/6 to 50/-	..
i	,, Wire, galvanised No. 8 ..	per ton	£9 15	..
g	Lead, English Ingot	per ton	£14 2 6	2/6 to 7/6 dc.
g	,, ,, Sheet	per ton	£15 15	5s. dec.
m	Manganin Wire No. 28	per lb.	8/-	..
g	Mercury	per bot.	£7 2 6	..
d	Mica (in original cases) small ..	per lb.	6d. to 1/-	..
d	,, ,, medium	per lb.	2/6 to 4/-	..
d	,, ,, large ..	per lb.	4/6 to 8/6	..
p	Phosphor Bronze, plain castings	per lb.	1/1 to 1/3	..
p	,, rolled bars & rods	per lb.	1/1½ to 1/3	..
p	,, ,, strip & sheet	per lb.	1/4	..
o	Platinum	per oz.	84/-	..
e	Silicium Bronze Wire	per lb.	10½d. to 11¼d.	..
i	Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
i	,, ,, in bars		£15 to £40	..
g	Tin, Block	per ton	£146 10 to £147 10	£5 10s. dec.
n	,, Wire, Nos. 1 to 16	per lb.	1/9½	½d. dec.
p	White Anti-friction Metals— "White Ant" brand	per ton	£46 to £70	..
j	Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	8d.	..
j	,, 6 lea. Flax	per lb.	5⅜d.	..
j	,, 3 ply 10 lbs. Russian ..	per lb.	4 11/16d.	..
j	,, 10 lbs. Russian, single ..	per lb.	4¼d.	..
j	,, 180 lbs. Jute rove ..	per ton	£11	..
k	Zinc, Sh't (Vieille Montagne bnd.)	per ton	£29 15	15s. inc.

Quotations supplied by Messrs.:—*a* G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Thos. Bolton & Sons, Ltd.; *d* F. Wiggins & Sons; *e* Frederick Smith & Co.; *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.; *g* James & Shakspeare; *h* Edward Till & Co.; *i* Bolling & Lowe; *j* Walter H. Hindley and Co., Ltd.; *k* Morris Ashby, Ltd.; *m* W. T. Glover & Co., Ltd.; *n* P. Ormiston & Sons; *o* Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

Carborundum Works in Germany.—The firm of Meyer & Schmidt announce that they are engaged on the erection of works for the production of carborundum in Baden-Rheinfelden. It is proposed for this purpose to utilise the water power of the Rhine to the extent of several thousands of horse-power. The German patent for the manufacture of carborundum was declared invalid two years ago, and since then large European works have supplied the requirements of Germany in this respect, so as to render the country independent of imports from America.

A Bad Specification.—The East Anglian Engineering Co., Ltd., of Stowmarket, have written to the local Press complaining of the action of the Ipswich Board of Guardians in inviting tenders for electrical machinery and specifying for a certain particular make. The firm contend that it is not business or fair trading to debar every other maker of electrical machinery from having a chance of tendering. They feel this the more as they are a local firm, and have something like 150 of their dynamos and motors installed in the district.

THE BRITISH ASSOCIATION MEETING IN SOUTH AFRICA.

The proceedings of the British Association for the Advancement of Science have been reported in considerable detail in the South African papers, and it is from the reports published in the *Cape Times* that we have prepared the following abstracts of some of the proceedings. Readers will remember that the papers on "Wireless Telegraphy" and "Distribution of Power on the Rand" have already been briefly touched upon.

Atmospheric Electricity.

A paper on "Observations on Atmospheric Electricity in South Africa," by Prof. J. C. Beattie, D.Sc., J. Lyle, M.A., and W. H. Logeman, M.A., was read. The observations carried out up to now consist of a series made at Bloemfontein in 1902-3 by Mr. Lyle, of the Grey College, Bloemfontein, and a less complete series made during the same period at Cape Town by Mr. W. H. Logeman. Observations have also been carried out in Cape Town by Mr. Fincham during the present year. The instruments used were an Elster and Geitel dissipation apparatus, and—less regularly—a Kelvin portable electrometer. The paper contains the records of daily readings of temperature, humidity, pressure, and both positive and negative leaks for morning and afternoon hours. These results are used to determine the annual variation; a harmonic analysis of the results being obtained in the usual way. Cape Town is on the coast, practically at sea level. Bloemfontein is inland, and about 4,500 ft. above sea level. The magnitude of the leak is greater at Bloemfontein than at Cape Town. The positive leak, both at Cape Town and at Bloemfontein, is less than the negative in the morning; the positive leak in the afternoon in Bloemfontein is greater than the negative in the summer months, and less in the winter months. In Cape Town, so far as the observations go, it seems probable that the opposite is true—that is, from June to October the positive leak is greater than the negative, and in November and December less. Mr. Lyle and Mr. Fincham had in addition observed on several days throughout the whole day. The chief results are similar to those obtained in Europe. Formation of fog leads to a diminution in leak. The rate of leak changes with the relative humidity and with the pressure.

The Magnetic Survey of South Africa.

This paper was read by Profs. Beattie and Morrison. A survey of South Africa was started by the authors in the summer of 1897-1898. The observational work has been carried on since that time whenever opportunity offered; naturally, it was greatly interfered with by the war. Soon after the declaration of peace the various South African Governments each contributed to a fund for paying the expenses of a field party for a year's continuous work. This party observed during the whole of 1903 and part of 1904. Financial assistance has also been received from the Government Grant Committee of the Royal Society. The necessary observations have been made at about 400 stations, distributed chiefly along the various railways in Cape Colony, Rhodesia, the Transvaal, the Orange River Colony and Natal, in the south of Cape Colony, the east of the Transvaal, the Basutoland border, and the north-west of Cape Colony. Observations have been repeated at 20 widely-separated stations for the purpose of determining the secular variations of the elements. The annual and the daily observations have been derived from the earlier work of Sabine in South Africa. It is hoped that the work of reduction will be sufficiently advanced by August to show isogonic and isoclinic maps of certain parts of South Africa.

Radio-Activity of Ordinary Matter.

Mr. A. Wood read a paper which consisted of a general survey of the evidence in favour of the view that radio-activity is a universal property of matter. Strutt's work had shown that the ionisation in vessels of the same size differed for different materials. There must, therefore, be a radiation from those different materials capable of ionising the gas contained in the vessels. This radiation was shown by Campbell and the author to consist of two parts, some of it being secondary and excited by the penetrating radiation from without, the remainder being intrinsic and proper to the material. Strutt regarded this latter as due to radio-active impurities, but since his work was published results have been obtained by many other experimenters. When these results are compared we find that the order in which the various metals tried occur is almost identical, and the author concludes that where different samples, tested by different methods, yield results in such close agreement, the idea that impurities play any considerable part may be dismissed. The author then proceeded to summarise the result of the efforts made by Thomson, McLennan, Campbell and himself to obtain evidence of the existance of an emanation from metals. All the evidence so far obtained is indirect, however. The paper concluded with some theoretical considerations which lead us to expect universal radio-activity, particularly the electronic theory of the atom and the old idea that the occurrence together of two closely associated metals, such as silver and lead, might be explained by the breaking down of the lead into the silver atom by a disintegration similar to that which takes place in the transformation of radium into helium.

Magnetic Intensity.

A paper on the "Daily Variation of the Northerly (X) and the Easterly (Y) Components of the Magnetic Intensity at Cape Town, St. Helena and Mauritius," was read by Prof. J. C. Beattie, D.Sc.

Electric Railway Traction.

A paper by Mr. A. M. Tippett, chief resident engineer, C.G.R., on "The Cape Government Railways," was read. Mr. Tippett treated this thoroughly from every point of view, and nothing in connection with the construction, management and working of the C.G.R. seemed too great or too detailed to come within his examination. He described the three systems, their routes, lengths and engineering and other features, and then he passed on to the classes of railways, the ordinary branch lines, the pioneer or developing railways, narrow gauges, bridge building, ballast, sleepers, water supply, signals, gradients, and so forth.

This paper led to some discussion on the question of electric traction.

Sir William Preece said that the chairman (Mr. R. H. Hammersley Heenan) had referred to the fact that the burning question of the year was that of electric traction. Well, electric traction at home and even in America was in a very tentative state. It required an immense amount of experience to form different opinions, and they had to watch with a considerable amount of interest what was going on in the rest of the world. He said that what they had to fight was not the troubles of electric enterprise as such. There was no doubt that the terrible financial distrust that existed in England was due to the unfortunate action of the Limited Liability Act, which had invented a new monster called the "Company Promoter." The "Company Promoter" had done more harm in England than any troubles or accidents that might have accrued from electric traction. They had very important railway problems to solve. They had tried during the past 12 months to see whether they could not in some way or other ameliorate their suburban traffic. The North-Eastern Co. had electrified a portion of their line, the Lancashire and Yorkshire had electrified a portion of their line between Liverpool and Southport, and other railways were contemplating establishing an electric system to work their traffic, but, most unfortunately, these two companies, the North-Eastern and the Lancashire and Yorkshire had adopted a system that was obsolete. It was very remarkable that with all the evidence before them they should have adopted a system which involved the use of the live rail. The Metropolitan Railway Co., some years ago, decided to electrify their line, and some very careful and well-conducted experiments were started, but the Metropolitan District Railway had now fallen into the hands of those who did not quite approve of what was being done. There was a very great and important point at issue, and that was which was the best system on which to work the railways—the continuous current or the alternating current. The alternating current had met with great success in Canada and in Italy, and also in Germany. The London, Brighton and South Coast were at the present moment contemplating the fitting up of one of their suburban lines in the south of London on the alternating current system. In London they would then have a splendid object lesson for comparing the relative advantages of the alternating current and the continuous current. A question often asked was whether it was cheaper to use electricity than it was to use steam? Most people seemed to think that the whole and the sole question was the relative cost of working the line by electric current as against steam. But, after all, it was not a question of the cost per unit of electricity and the cost of steam, but rather of the advantage that the current would have in expediting the rate at which they could get up their speed and maintain it in working their line. It was quite evident from experiments which had been made and the experience of other lines that on such a line as the Metropolitan they would, by electricity, be able to get through their line one-third more traffic. That was due to increased acceleration possible by electricity as compared with steam. The day would come when what could not be done by steam would have to be done by electricity. "When we came to the limit of our suburban traffic we should be able to increase the capacity of the line by electricity. There was not the slightest doubt that when powers were obtained the electric railway between Manchester and Liverpool would be able to run at the rate of 120 miles an hour. That meant that the journey between Liverpool and Manchester would be done in 20 minutes instead of three-quarters of an hour, as at present."

Mr. Alex. Siemens said that in Germany they had been running trains at 120 miles an hour, so that it was not a question of what might be done, but what was being done. Mr. Siemens referred to some of the results of experiments conducted with overhead lines.

Mr. Robert Hammond said it seemed to him that there was a very remote chance of the Cape railway running at the rate of 120 miles an hour. It would be a curious thing to see such an experiment carried on upon certain portions of those lines. He would rather view it from the top of the mountain than from the train. There was one portion of the line which, when he was there three months ago, struck him as particularly suitable for electric traction. Sir Wm. Preece had very well put it that, quite irrespective of long-distance and high-speed railways, which were not applicable to the case of the Cape, an important advantage of electric traction was the high rate of acceleration. It was a matter which was especially of importance in suburban traffic. By means of quick acceleration there was a great saving of time without increasing the maximum speed, and it gave a manager "something up his sleeve" in case of delays. By means of electricity they could obtain their maximum speed much more quickly, and continue it for a time. He thought the experience of the North-Eastern Co., which had electrified its suburban line north of the Tyne, showed an immense advantage, by the use of the multiple unit system. He trusted that next time the Association came to South Africa they would find that something had been done in regard to the electrification of railways.

Mr. F. Douglas Fox said it seemed to be now settled that the standard gauge of the South African railways was 3 ft. 6 in. Although it was not a gauge that would stand a high speed, it seemed to be a very suitable standard. In local traffic he did not think that in the Cape and Durban, for instance, they could do better than adopt electric traction.

Mr. J. Denham referred to the electric lighting of the Cape Government railway trains, and gave an interesting account of the various systems which had been adopted. Touching on electrification, Mr. Denham said that they knew that electrification of the Wynberg line was a desirable thing, but there was, they had to bear in mind, a mechanical drawback. Unfortunately, they had only got a 3 ft. 6 in. gauge, and they could not get, as far as he knew, the horse-power necessary for an electric train running 50 miles an hour on that gauge.

Prof. Payne said that in reference to the 2 ft. gauge it seemed to him a great pity that the Port Elizabeth-Avontuur line should have been built on the narrow gauge. Instead of building a 2 ft. line, the Government should either have built a 3 ft. 6 in. line or no line at all, because if they had built no line at all they would have left it open to a company to run motor carriages.

Mr. Oats, M.L.A., said, in regard to electrification, he did not profess to be a railway engineer, but it always seemed to him that a great improvement which might be made in the future would be when they could dispense with the necessity of dragging up steep gradients, such as they had in that country, the full weight of an engine and boiler. He thought more power was absorbed in hoisting the engine and boiler up these mountain sides than in the load itself. In regard to suburban traffic, he thought that there was room in that direction for the development of electric traction.

Mr. Tippett, in replying on the discussion, said that in the present lamentable condition of the country, and in view of the fact that the traffic was diminishing rather than increasing, the prospects of the electrification of the suburban line were somewhat remote. He thought there was room in the colony for a body exercising similar functions to the Board of Trade.

Roller Bearings.

In the absence of Mr. T. H. How, who could not go to South Africa, a paper on "Roller Bearings" was read by Mr. W. Bayley-Marshall. The author, whilst contending that roller bearings should be produced at reasonable cost, regarded first cost as secondary to ultimate economy in motive power, measured by savings in coal or electrical current per annum, and lubrication. Recent tests on line shafting electrically driven, fitted with roller bearings, showed a saving of 24·4 per cent. of the power required to run the motor and countershaft with machines in full work. Earlier unsuccessful experiments made with roller bearings were attributed to causes now well understood and avoided, such as excessive rigidity and improper load adjustment, which are now obviated by means of swivel seatings, so that the load is evenly distributed. Examples were given of roller bearings successfully applied to the axles of coal-weighing shoots, each bearing supporting a load of 5 tons on eight rollers on mild-steel axles, where the total tractive resistance was reduced to 3 lb. per ton of load. In tramway and railway vehicles a series of tests had also proved the starting effort to be 3 lb. per ton of load, giving a coefficient of friction of 0·0013, including wheel friction upon straight, level rails. This reduction effected a saving in electrical energy equal to 50 per cent. of journal friction, equivalent to ½d. per car-mile, or £50 per car per annum. On the Birmingham electric tramways a saving of 24·30 per cent. of tractive force per ton of load was obtained, and a saving of 1·035 units per trip, equivalent to £38 16s. 3d. per car per annum. At Southport the average energy consumption of roller-bearing cars was 0·55 unit per car-mile, with a mean speed of 10·3 miles per hour, as against one unit per car-mile with ordinary bearings and a mean speed of 8·6 miles per hour. The mean current consumption with ordinary bearings was 0·797 unit per car-mile, and with roller-bearings 0·389, showing a saving of 0·408 unit per car-mile, or a saving of £68 per car per annum. As examples of railway tests, the earlier trials on the London, Brighton, and the South Coast Railway were cited, where, after six years' service and 120,000 miles run, a saving of 12½ per cent. was shown in coal consumption. On the Liverpool Overhead Railway, roller-bearing tests proved that the reduction per ton-mile of coal consumption was equal to 9 per cent., and that longer trains could be employed. The reduction of tractive resistance and the correspondingly diminished wear and tear of materials generally, combined with increased comfort in smooth, easy running, the smarter handling of trains, the acceleration of speed, and the increase of carrying loads by means of successful roller-bearings, were subjects well worth the careful consideration of engineers.

Prof. T. Hudson Beare said that in discussing the matter of roller-bearings with Prof. Goodman, of Leeds, he learned that it was difficult to get the rollers truly parallel, and that it was found that the necessary provision for end thrust or lateral movement made it difficult to get trustworthy results, that was to say, that the results of one day's experiments did not correspond with those of another. Then, as to economy, the figures given were very striking; but he would like to ask how long the cars referred to had been running with roller-bearings, and whether, in the calculations set forth, allowance was made for the great depreciation, because the life of the bearings should be shorter on tramcars running over the rough road surface than on railway rolling-stock running over a smooth track. He was confident that roller-bearings had a great future before them.

Mr. W. Bayley Marshall, in reply, said that the first experiments made with roller-bearings had been anything but successful. He himself, had tried case-hardened lap rollers, as nearly parallel as humanly possible, but the question of parallelism asserted itself, and the rollers frequently crossed. Then Prof. Woodcock adopted a floating cage to keep the rollers parallel, and that had proved successful. The Birmingham tramcars had been running with roller-bearings for two years; but, because of the municipalisation of the tramway system, and as the municipality was now building its own cars, they had been abandoned. That was why they were not now in use on the Birmingham trams.

The Motor-Car in South Africa.

Mr. A. T. Hennessy read this paper, in which motor-cars were divided into three classes: electric, steam and internal combustion or petrol. In regard to electric cars, he said that they only required to be briefly dealt with as far as South Africa was concerned. Though electricity was the ideal motive power, no accumulator yet invented could stand the vibration of their roads, and even were the roads suitable the small storage capacity of any electric car, combined with the fact that only an extremely limited number of centres for recharging were available, thus rendered the electric motor-car for practical use out of the question. In his opinion, the future of the motor-car, in South Africa at all events, was with the petrol car, and that view was shared by every practical motorist of Colonial experience. It was understood that a local engineering firm proposed shortly to take up the manufacture of motor-cars for that country, but with the present limited demand for such, it was not probable that more would be done than to assemble the various parts of the car imported in the first instance from Europe or elsewhere. The writer would, however, welcome such a step as an initial attempt to cater for their special requirements. No one who had any knowledge of the country could doubt that the future of the mechanically-propelled vehicle in South Africa was a great one, and that the engineer and manufacturer, who at this early stage of motor development out there took up the question of designing and manufacturing vehicles suited for their roads, would reap a substantial harvest in the near future as a reward for their energy and foresight.

Sir W. H. Preece, in setting forward the claims of electric cars, said that their great drawback was the difficulty of finding a storage battery of sufficient capacity to take the car a long distance. The car of the future must be an electric car. It swept away at once all the troubles, annoyances and vexations of the petrol and steam cars. The great objection to the petrol car was its smell; there was no smell in the electric car, neither was there any vibration. With regard to the battery for electric cars, he had been looking out for a suitable one for some years, and he had laid down two distinct conditions, the first of which was that it must take a charge which would drive the car for 100 miles. If one could do that in England, it would be possible to use a motor-car all over the United Kingdom, for in no part would one be more than 75 miles from a charging station. The car he had made was not built for long runs; the best electric would not get over the objections which Mr Hennessy had laid down. He (Sir William) was quite sure the South African roads were not suitable for electric cars, but his car was one he designed to do service between his house and the railway station, 2½ miles away. The electric car had this great advantage, that one could not, if one wished, set it to go at a speed greater than the maximum legal limit—20 miles an hour. At the present moment he would not say that his car had been a success. It had been abominably turned out from an electrical point of view, but as a sample and as an experiment in the possibilities and potentialities of the electric car, he confidently believed that over smooth roads and short distances, and for suburban traffic, it was superior to the petrol or steam cars.

Prof. Hele-Shaw said Sir William Preece had not told them anything about the cost of his electric car. Except for use in the streets of London, he (the speaker) had relegated them mentally either to millionaires or to newspaper proprietors; now they must include Sir William Preece.

Prof. T. Hudson Beare advocated the use of alcohol motors for South African cars.

Mr. Hennessy, in reply, said that admitting all that Sir W. H. Preece had said about electric cars, he still maintained that they were unsuitable for South Africa.

THE DISTRIBUTION OF POWER.

By W. E. Ayrton, F.R.S.

(Abstract of Lecture delivered on August 29th, at Johannesburg.)

It was in Paris, at the Palais de l'Industrie, the home of that Electrical Exhibition of 1881—which has now become classical—that modern electrical engineering was born.

In 1886, when the boy Electricity was five, the babe Johannesburg was born, and the two youngsters have raced along neck and neck.

In 1888 it was beginning to be realised that a pressure of 2,000 volts between electric mains might not make too great a call on the funds of Life Insurance Companies.

In exactly a decade after the Paris Electrical Exhibition of 1881, came the Frankfort Exhibition of 1891. More than ten times 2,000 volts was there used to transmit more than 100 H.P., more than 100 miles, with more than 75 per cent. efficiency.

The table on page 477 shows that the use of higher and higher pressures has enabled larger and larger amounts of power to be transmitted longer and longer distances, with greater and greater efficiency, that is, with less and less waste.

In the distribution of power, current and pressure are equally important. It is not merely because, even this month, after a

phenomenally dry season, about 5,000,000 gallons of water are rushing per minute over the Victoria Falls, but also because this water thunders down about 380 ft., that these Falls are a potential source of power.

Probably, like myself, you have heard vague comparisons made between the power of the Victoria and the Niagara Falls. Now, what is the true comparison?

The flow at Niagara varies at different times of the year from about 62 to 104 million gallons per minute. At the Victoria Falls the flow can be one-twelfth of the smaller number—for it is so now; and some authorities, well acquainted with the spot, say that at the end of another three months the flow will be only half of even that. The mean available drop at Niagara is about 160 ft.; at the Victoria Falls, about 380 ft. Hence, while the minimum Niagara flow represents about 3,000,000 H.P., the present Victoria flow represents about 580,000 H.P., or only about one-fifth of the preceding. Further, if those who predict the flow of the Zambesi sinking to something like 2½ million gallons per minute in November, are true prophets, the Victoria Falls will then only give out about 300,000 H.P., or, say, one-tenth of the minimum that Niagara produces.

—	1882. Hirschau to Munich.	1883. Vizille to Grenoble.	1886. Creil to Paris.	1891. Lauffen to Frankfort.
Pressure at transmitting end in volts	700	3,000	6,000	25,000
Horse-power delivered by electro-motor	5·8	7	52	114·2 to lamps
Distance in miles ...	3·5	8·75	35	108·7
Percentage commercial efficiency of transmission	36	62	45	75·3
Diameter of line wire in inches	0·18	0·079	0·2	3 wires each of 0·158
Material of wire ...	—	Silicium bronze	Copper	Copper

In all that precedes I have taken the full power of the direct drop in each case; that is, I have assumed in each case the intake to be close to the main drop, and I have deducted nothing for inefficiency of machinery.

In 1897 two transmissions were arranged for at 33,000 volts—the one at Crofton, California, and the other at Redlands, California. And no pressure higher than that used on the Lauffen-Frankfort transmission seems to have preceded this 33,000 volts anywhere in the world.

In 1898 the highest working pressure in the world was 40,000 volts for a 34-mile transmission at Provo, in Utah, and last year there were several examples of transmissions at 60,000 volts, as seen from the following table:—

Year	From	To	Country.	Transmission distance in miles.	Horse-power transmitted.	Pressure at transmission end in volts.
1897	Crofton	—	California	—	—	33,000
,,	Redlands	—	,,	—	—	,,
—	—	Bangalore	India	92	4,300	35,000
1898	Provo	—	Utah	32	—	40,000
—	Gromo	Nembro	Lombardy	22	3,300	,,
—	Logan	Salt Lake City	Utah	150	2,600	,,
—	Canyon Ferry	Butte	Missouri	70	5,700	50,000
—	Shawinigan	Montreal	Canada	90	15,000	,,
—	Moutiers	Lyons	France	112	—	57,600
—	Spokane	Washington	—	100	3,000	60,000
—	—	Guanaguato	Mexico	104	4,000	,,
—	Electra	St. Francisco	California	147	10,000	,,
—	Colegate	Stockton	,,	218	5,000	,,

Indeed, not only have various successful 60,000-volt transmission schemes been carried out, but the Kern River Power Co. in California are constructing one for transmitting 4,020 H.P. over 110 miles at 67,500 volts.

When the new railway—Brakpan to Witbank—is completed, 110 miles will be 20 more than will separate the Rand from the coal fields at Witbank—fields that produce such good coal that the Central South African Railways have contracted to purchase 84,000 tons during this year, at 6s. per ton at the pit's mouth. Now, at a pressure of 67,500 volts, these two small wires could, without warming, bring about 9,000 H.P. from Witbank and deliver 7,600 of it to the Rand.

Or if six wires were used like those now employed by the Rand Central Electric Works, then, at 67,500 volts, 9,000 H.P. might be put in at Witbank and only 5 per cent. lost on the road, that is, about 8,950 H.P. delivered on the Rand.

You will now grasp why in 1895, 10 years ago, it was a bold and pioneering policy to equip the Rand Central Works for 10,000 volts, and to use 13,000 volts during times of full load, but why in 1905 the recommendation of some advisers to distribute power at only 10,000 volts to the proposed sub-stations of the contemplated 57 miles of electrified railways—Springs to Randfontein, is most retrograde of those advisers to the railway.

Next I come to a very important question, and one that merits far more consideration than it has yet received. There are two kinds of electric current—direct current and alternating current. Now, which kind of electric current should be used for the distribution of power over *long distances?* Practically, every electrical engineer will at once reply: alternating, of course. Well I am going to preach heresy.

The alternating current has undoubtedly the great advantage that a motor can be constructed with no rubbing electric contacts; an alternating current dynamo can be constructed to produce a large horse-power at a high voltage; and further, as we have already seen, this alternating voltage can be transformed into a still higher one without the use of moving machinery.

On the other hand, no single large *direct* current machine has ever been constructed to generate more than about 3,500 volts, and no means is known for efficiently converting a direct current voltage into a higher, or a lower one, without the use of moving machinery.

So far then my case seems weak! The advantages of using great electric pressures we have seen. Are there any disadvantages? This is a disadvantage, the risk of piercing the insulation! While from the point of view of economic transmission 60,000 volts alternating means exactly the same as 60,000 volts direct, from the point of breakdown of the insulation, 60,000 volts alternating is as bad as 85,000 volts direct—indeed, may be worse than 100,000 volts direct.

But there are other disadvantages in the use of alternating current.

The self-inductive effect is small, if the going and return conductors be straight, short and near together. But, if the distance over which the power is to be transmitted be long, the wires obviously cannot be short, and, if to obtain economy high electric pressure be used, the wires cannot be put very near together, since that would lead to a brush discharge through the air from one conductor to the other, producing leakage.

Indeed, the minimum distance that must separate the conductors has to be increased very rapidly with the pressure. The table gives this minimum distance for conductors, $\frac{1}{10}$th, $\frac{2}{10}$ths and $\frac{4}{10}$ths of an inch diameter respectively. It is to be noticed that increasing the thickness of the wire greatly diminishes this minimum. For instance, at 80,000 volts, doubling the thickness of the wire from $\frac{1}{10}$th to $\frac{2}{10}$ths of an inch diminishes the minimum distance from 6½ ft. to 13½ in.

Johannesburg.—*Elevation, 5,689 ft., January, 1905; Barometer, 24·3 in.; Temperature, 91·5° F. Minimum distance that must separate two parallel wires to prevent the starting of a brush discharge.*

Electric pressure in volts between wires.	Diameter of wires in inches. 1/10	2/10	4/10
40,000	8·8 in.	—	—
50,000	32·2 in.	—	—
60,000	9·9 ft.	14·7 in.	—
70,000	35·7 ft.	33·8 in.	—
80,000	—	6·5 ft.	13·6 in.
90,000	—	—	23 in.
100,000	—	—	38 in.

It must, of course, be remembered that these are minimum distances, and that the distances apart at which the wires have actually to be fixed in practice are much greater.

But that is not the whole indictment against the use of alternating current for *long distance* transmission.

The very first thing that struck Ferranti when he commenced transmitting power with alternating current at 10,000 volts pressure from Deptford to London, was that the current flowing into the system at Deptford was as large during the daytime, when practically no lamps were turned on in London, as during the evening, when many were glowing. And in the case of the 150 miles transmission, at 50,000 volts, by the Bay Counties Power Co., in California, it was found that to charge even the aerial lines as a condenser required 40 amperes, so that the current flowing into the system remained practically unchanged when the useful load was decreased from several thousand horse-power down to nought.

Now with direct current for long-distance transmission, there is no question about the electric pressure at the top and bottom of a wave being much greater than the mean pressure, no question about self-induction reducing the current—no objection, therefore, to putting the conductors as far apart as the risk of brush discharge may necessitate—no question about capacity current, no resonance troubles, &c.

Power up to 3,000 H.P. has been transmitted with direct current at 14,000 volts, from Combe Garot to Le Locle and La Chaud de Fonds, round a circuit 32 miles long; 4,600 H.P. has been transmitted with direct current at 23,000 volts, 35 miles, from St. Maurice to Lausanne; and a transmission system for 6,000 H.P. at 60,000 volts, over 114 miles from Moutiers to Lyons, is in course of construction.

Another advantage that is possessed by all these examples of direct-current transmission carried out by M. Thury, is that it is the current that is kept constant, and the electric pressure that is automatically raised, when the demand for power is increased, whereas, with the ordinary alternate current system, it is the pressure at the lamp end that they aim at keeping constant, and the current that varies automatically with the demand for power.

Now, it is far more easy to maintain the constancy of the current flowing round a long circuit than to prevent the bobbing up and down of the electric pressure at the distant end of a long transmission line.

Constant current has also its well-known disadvantages, but these would not come into play if the constant current were not taken into houses, mines, &c., but used to drive motor-generators in sub-

stations, the dynamo portion of the motor-generator being of any type desired.

The pioneering development that American boldness, enterprise, initiative and originality have brought about in the electric distribution of power, combined with the extraordinary commercial success that it has won on both sides of the Atlantic, have made people ask, "Is such an industrial revolution in store for South Africa?"

At first sight one is inclined to answer, "No!" This country is dotted with coal fields—coal fields blacken the map, and the produce of some of them is reported to be nearly equal to the best Welsh coal in quality.

When, on the one hand, one hears that good coal is brought from Witbank and delivered to the mines on the Rand at 13s. a ton, and that even this price will be lowered on the completion of the new railway from Witbank to Brakpan, one feels that long-distance electric distribution has not much chance—indeed, a proposal to burn slack coal at Vereeniging, only 33 miles from Johannesburg, and electrically distribute the power on the Rand, fell through.

On the other hand, when one finds that at the Wankei coal fields themselves large coal costs 15s. a ton *at the pit's mouth*, and that Salisbury pays 36s. 5d., Umtali 43s. 6d., and Kimberley 67s. per ton, one feels that electric distribution in this country possesses possibilities.

South Wales has many coal mines—cheap slack coal lies heaped at the pit's mouth. If an Electric Supply Distributing Co. were to start in South Wales to obtain their electric energy, *not* from waterfalls, mark you, but from coal brought to their generating stations from coal mines, would you anticipate that such a company would obtain customers for their electric energy at coal mines themselves? And yet within four years since that South Wales company was merely applying to Parliament for an Act to enable them to establish a distribution of power system, 14 of the largest colliery companies and 30 of the mines are taking power at about ½d. a horse for an hour, the demand three months ago having reached 13,000 H.P., and rapidly increasing.

Niagara sends 24,000 H.P. to Buffalo, 30 miles away, and sells it at 0·7d. per H.P.-hour to an eight-hour user there—a price which is *not* cheaper than the total cost of generating a H.P.-hour at Buffalo with a *large* steam engine. But tapping electric wires to obtain any amount of power that may be needed, and just at the time that it is required, is far more convenient than erecting steam engines and getting up steam, and certainly cheaper in the early days of sinking a mine.

It has been objected that the total steam power curve of all the gold mines on the Rand shows the same sort of falling off during the hours 4 to 7 a.m. and 5 to 8 p.m., and, therefore, that, apart from using larger and more economical engines and from diminishing the cost of superintendence for the energy sent out, there would be no saving by supplying many mines with electric power from a common generating station. But if there be a railway in the neighbourhood, largely used by workmen, the slack hours on the mines will be the busy hours on the railway. Hence, if that railway be run electrically from the same generating station, the load curve will be flattened and much improved.

But, while advocating electric transmission of power, I should not start by constructing a transmission line from the Victoria Falls to Johannesburg. And I say that, not because I am of opinion that it could not be made to work, nor that, if direct current were used, it could not be relied on to give as satisfactory results as, or even better results than, some shorter existing ones on the alternate current system, but because it does not appear to me that along the route there is at present sufficient demand for power to justify as large an expenditure of capital as would be compatible with a transmission line 586 miles long as the crow flies, and which would be no less than 745 miles long if made along a railway through Pietersburg and Gwanda, should that missing stretch of railway between these two places ever be constructed.

The total electrical horse-power that could be sent out from the various Niagara power houses, when completed, will approach 700,000 H.P., and represents about 30 per cent. of the water going over the Falls at the time of minimum flow. But taking into account the further fact that water is already abstracted to feed the Welland Power Canal and the Chicago Drainage Canal, and that other canals are projected, Mr. A. D. Adams has estimated that about 41 per cent. of the minimum flow of Niagara will cease to pass over the Falls. In fact, the water that will cease to pass over the Niagara Falls will be nearly five times as large as the total amount passing over the Victoria Falls to-day.

The "Thunder of the Waters," the "Cataract of Fearful Height," in America, which have inspired us and our ancestors with reverential awe, may appeal to our descendants as only a vast electric generating station. Very gratifying to us as engineers, extremely distressful to us as lovers of the beautiful.

Now what has caused this vast development in the distribution of power, what is the secret of this extraordinary success? It is that in the immediate neighbourhood of the Falls there have grown up works which take some 60,000 H.P., works which not only want cheap power, but power in an electric form for electro-chemical processes, and need it in an undiminished amount, day and night, week-day and Sunday. The Carborundum Co., which manufactures emery's rival grinding material, furnishes an absolutely steady load of 5,000 E.H.P., the Union Carbide Co. 15,000, and so on, loads which, from their magnitude and their absolute steadiness, make the electric light engineer's mouth water.

Now what is the prospect of such a steady load growing up locally within, say, three miles of your Falls? Even on the spot it is difficult to obtain trustworthy information; by some it is said that one condition of the contract for the construction of the railway, which is being pushed forward to the copper, lead and zinc fields at Broken Hill, 400 miles to the north-east, is that 100,000 tons of the ore must be sent to Beira yearly for 10 years. If true, then that ore will not be available for reduction at the Falls.

There is a convenient spot for a power station near the water at the end of the second gorge—all the Niagara power stations are on the top of the Falls, with the exception of that of the Ontario Power Co.—and it is the latter method of construction that would be the most suitable to follow at a Victoria power station.

But jealously guard the beauty of your Falls. The protection of the grandeur of their American sister was the underlying idea of Thomas Evershed's hydraulic power scheme of 1886. How little has that object been kept in sight?

Niagara *was* glorious nature, to-day it is power; Victoria is poetry.

NEW ELECTRICAL DEVICES AND FITTINGS.

We commence below a description of some of the new electrical specialities which are now being, or have lately been, introduced to the market:—

New Workshop and Office Lamp Fitting.

This fitting, the invention of Mr. R. W. Bill, of Handsworth, has been designed for use in places where it is required to move a lamp into different positions and so throw the light into any desired direction. The fitting consists of a wall bracket or table stand with a flexible suspender or support (provisionally protected) attached, and this suspender is flexible yet will support a good weight at its end in any position.

The suspender consists of two members, an inner and outer. The outer, which is built up of sections with ball-and-socket joints, is made of any light material which is strong and has a high coefficient of friction. The inner, which pulls the outer sections together, is made of a stranded hard-drawn steel wire, with a wing nut and screw adjustment at one end. This steel wire has a breaking strain of about 5 cwt. The friction of the joints of the outer

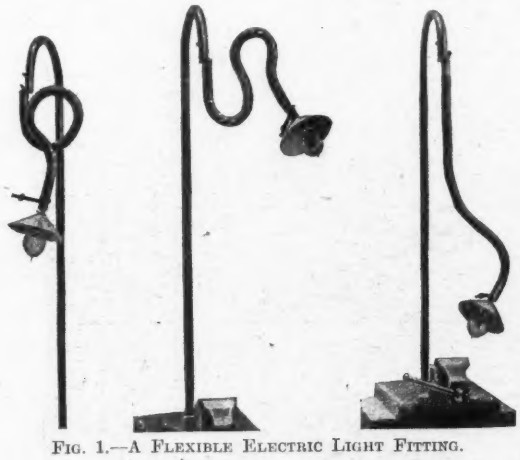


Fig. 1.—A Flexible Electric Light Fitting.

section, pulled together by the inner wire, is sufficient to support a lamp and shade easily in any position. We given some illustrations of this fitting, showing the suspender in various positions with a lamp attached, and it will be seen that the suspender can be bent into any shape or form and will support the lamp. In case the joints work loose, one wing nut is all that is required to be tightened, and this pulls the whole series of joints tight. It is claimed that this fitting is preferable to a swinging stiff tube, as the range of movement of the lamp is limited in the latter case.

Lists and samples will shortly be issued to the trade by Messrs. S. Bill & Co., 56, Guest Street, Birmingham.

Foster New Arc Lamp.

It may be remembered that in 1902 a new electric arc lamp of very simple construction and exceptionally high efficiency was placed upon the market by Messrs. Foster & Co., of Wimbledon. The great feature of this lamp, apart from the very low current consumption, consisted in the elimination of the dashpot and shunt coil until that time considered essential to the proper working of an arc lamp. The natural evolution which invariably ensues on the introduction of any new principle or mechanism, backed by the determination of the inventor to produce his very best, has resulted in the 1905 Foster lamp. This lamp embodies all the advantages of the old one, but is much easier to handle, while the mechanism has been considerably strengthened all round. A new patent reflector is now being introduced which embodies some valuable features. These reflectors have not the innate ugliness of the old type of hood reflector; on the contrary, they are of handsome appearance, being of antique metal scroll work and finished in bright and oxidised

copper. A more interesting invention is the Foster small pattern lamp, an illustration of the exterior of which is annexed. This lamp is only about 1 ft. long. The case is made of solid copper, and the internal mechanism, for the size of the lamp, is very strong and thoroughly well finished. On alternating current this lamp will produce a light of about 200 c.p. for a power consumption not more than that taken by three or four 16-c.p. incandescent lamps. By a new process this lamp will burn for 60 to 100

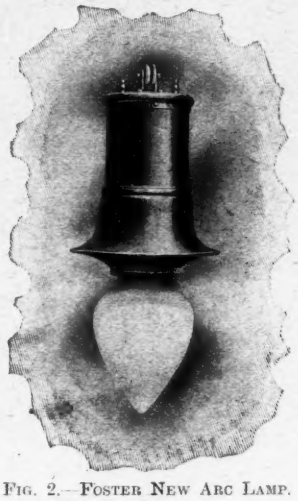


Fig. 2.—Foster New Arc Lamp.

hours without soiling the globe to any material extent; and the method of renewing the carbons is exceedingly simple. Owing to the very small size of the lamp it has been impossible to use the Foster hot wire, but, nevertheless, there is no dashpot and no shunt coil. These lamps, we are told, will run on any alternating circuit, and can be fixed without any alteration to wiring in place of three, four and five-light fittings.

J. & P. New Motor Starter and Switch.

In the accompanying illustrations are shown two new special lines of Messrs. Johnson & Phillips, Ltd., of Old Charlton. Fig. 3 is an enclosed gas-tight type of direct current motor-starter. It is

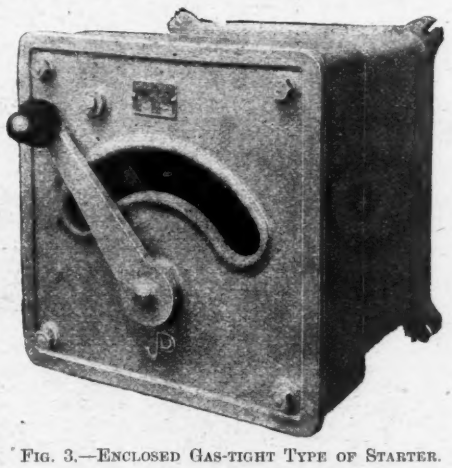


Fig. 3.—Enclosed Gas-tight Type of Starter.

operated through a ratchet and pawl motion, preventing too rapid starting up, arranged so that, although the operator keeps his hand on the starting handle, an overload or absence of voltage breaks the circuit. All the switch parts carrying current are of substantial design, and ample carrying capacity, thus preventing undue heating. There is also an absence of destructive sparking on opening the circuit, should the starting switch be used for this purpose. Provision is also make for making the shunt in advance of the armature circuit, and breaking the shunt circuit through a non-inductive resistance. The entire switch and resistances are made to standard jigs and templates, and can be replaced from stock. For the smaller sizes of starter a porcelain type resistance unit is used, while for the larger sizes an ironclad type, consisting of resistance material and insulation, clamped together by cast-iron caps, is employed. In the latter resistances there is an entire absence of soldered joints, which, together with the solid construction of the units, ensures an absolutely indestructible resistance, even under heavy overloads. The resistance is designed and divided up so as to give a constant current increment on each contact, thus avoiding undue strains on the motor or gearing. The resistance, whether of porcelain or ironclad type, is easily removed, for inspection, from the containing box.

In fig. 4 there is shown a gas and water-tight type of switch suitable for mining work. It is made suitable for circuits up to 600 volts, constructed with ample capacity and provided with quick-break movement. It has a long break and is enclosed in a cast-iron

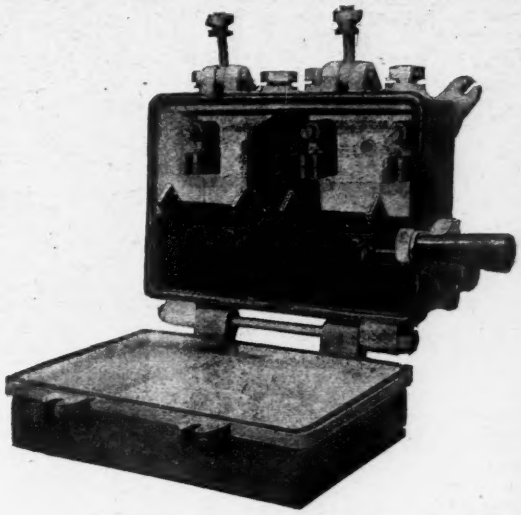


Fig. 4.—Gas and Watertight Switch.

case, lined with asbestos and provided with outside handle. The switch cannot be left in any other than the "on" or "off" positions. Each pole is mounted on a separate porcelain base, a substantial insulating partition being provided between the poles. The spindle passes through a gas and water-tight gland into the case. The hinged lid is provided with a rubber ring, so that when closed a perfect joint is made between the lid and the box. Suitable rubber glands are provided where the cables enter the box. The holes can be screwed if required for gas, Simplex or other threads. The handles are made of highly insulating material.

Aston-Worsley Arc Lamp Gear.

In the accompanying figures we show Messrs. Veritys' automatic clutch and contact (Aston-Worsley patent). This device is designed for the easy manipulation of arc lamps suspended from

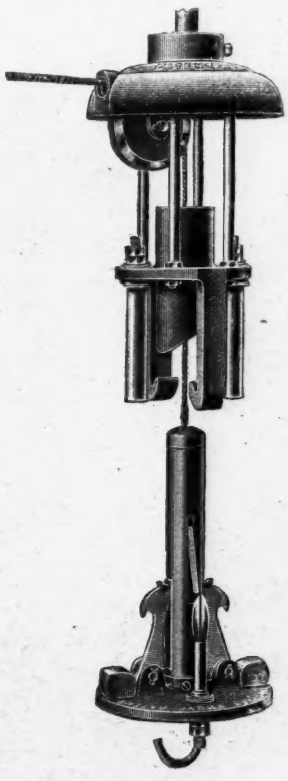


Fig. 5.

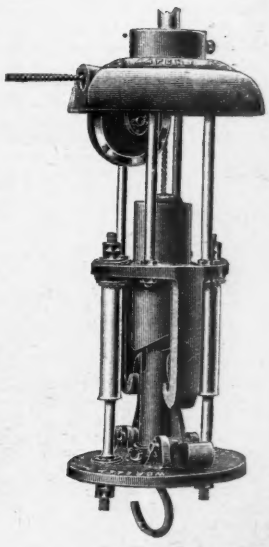


Fig. 6.

brackets or lofty ceilings, so that by means of a winch and suspension cord they may be lowered to the ground to be trimmed and hauled up again into position without an unsightly festoon of cable.

The contact gear is made to support a weight of over 1 cwt., and is so arranged that when hauled up into position the whole weight of the lamp or other article suspended from the gear is taken off the cord and supported by hooks provided in the gear. The latter consists of two parts, the upper part with a hooded dome, from which the supporting hooks depend, and the lower part on to which the lamp or other article is attached. All the movable parts are contained on this lower half, so that should anything go out of gear at any time, it can be lowered for attention at ground level. The device for hooking is simple, consisting of two large hooks which by gravity come into contact with two other hooks hanging from the top part, and a small catch-piece which is loosely fixed midway between the two movable hooks. This catch-piece only comes into play when the lower part of the contact gear is hauled up into position. When the gear is required to be lowered, a slight turn of the winch in the direction of hauling up is made, and then the hooks disengage, and the lamp or other article can be lowered to the ground. The contacts are specially large, and are of the plug type and self-cleaning. A neat cylinder effectively protects the gear from the weather. There are no springs or delicate parts in this gear to get out of order. Fig. 5 shows the top and bottom contacts about to engage. Fig. 6 shows the clutch and contact in use, the weight being taken off the cord.

Cyclone Electric Blower and Exhauster.

Messrs. Matthews & Yates, Ltd., of Cyclone Works, Swinton, near Manchester, are supplying the Cyclone electric blower and exhauster which we illustrate in fig. 7. This is a combination of their light pattern blower and exhauster (as constructed for general ventilating work where high pressures are not required), and their semi-enclosed type continuous current motor. It is adapted for ventilating public buildings, hotels, restaurants, &c., as it can be placed in any out-of-the-way corner, and air trunks carried to it. There are no belts or other driving arrangements required beyond the

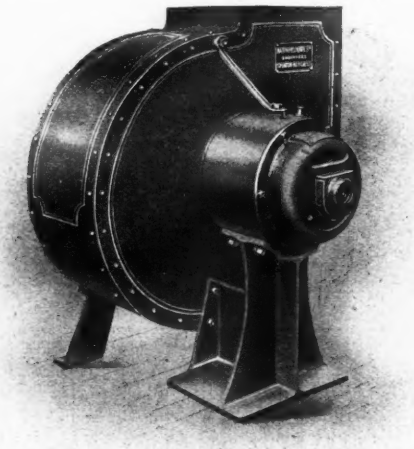


Fig. 7.—Cyclone Electric Blower.

electric wire connections to the supply circuit. It is built right or left hand and to discharge in any position, viz., top or bottom horizontal discharge, vertical up or down discharge, or at any angle between, as may be required to suit any special purpose.

Ventilating Frames and Covers.

The Franklin patent ventilating frames and covers supplied by Messrs. Rowland Carr & Co. are, we understand, being largely adopted by electrical and consulting engineers in this country and abroad, and at the present moment they are being used at Portsmouth and Pembroke Dockyards. They are designed to ensure a perfectly ventilated pit. Although by their use free ventilation to the interior is afforded, they are so constructed that no water can enter the pit, condensation does not occur, and there are no slots to

Fig. 8.—Franklin Ventilating Covers.

become clogged, thus obviating the necessity for periodical inspection for the purpose of clearing the ventilating channels. The frames and covers prevent all chance of gas or other explosions. They are made suitable either for pavement use or for roadway work, and if required, are also supplied with an arrangement whereby the surplus water from the channels may be conveyed to the nearest drain.

New Patent Brush-Holder.

The accompanying illustrations show a new brush-holder, which presents many novel and interesting features. It has just been brought out by Electromotors, Ltd., who have felt the need of a thoroughly reliable brush-holder for their range of small motors; the latter are often placed in situations difficult of access, or in the

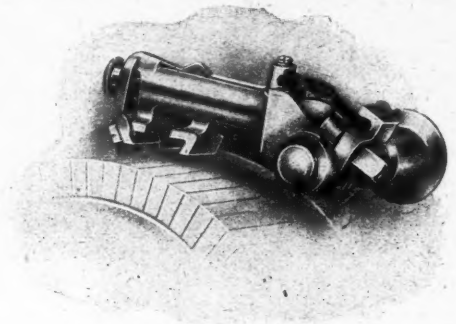


Fig. 9.—Brush-Holder in its Lowest Position.

hands of unskilled persons, so that they receive hardly any attention, and that often very inadequate.

The holder calls for but little description, the illustrations speaking for themselves. We may, however, say that inside the

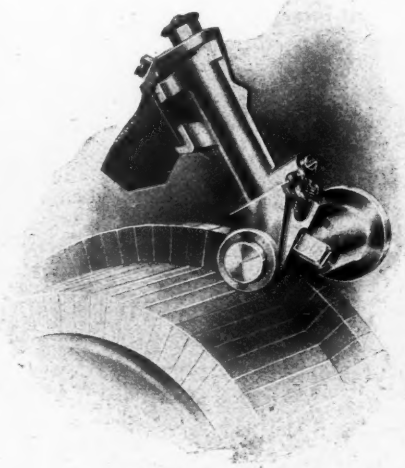


Fig. 10.—Brush-Holder Raised.

hollow stem of the holder proper there is a spiral spring, which is compressed between a knurled regulating screw at the outer end, and an iron plunger at the inner. The plunger abuts against a cam

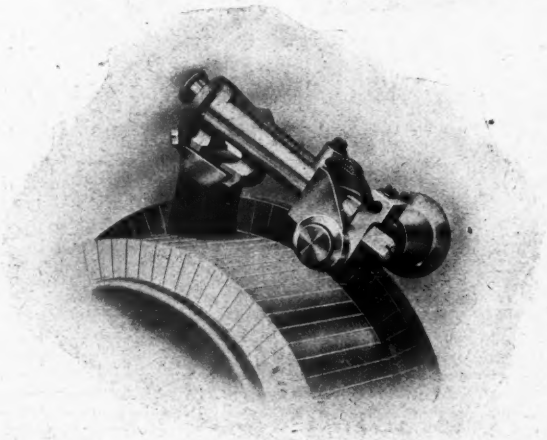


Fig. 11.—Normal Working Position.

on the fixed part, in such a way as to cause the stem to tend to rotate round the spindle; the cam is so shaped as to prevent the stem from rotating so far as to bring the metal parts of the holder in contact with the commutator; while, on the other hand, when

the stem is raised, the plunger passes over a dead point, and holds the brush in the "off" position, in which a worn-out brush can be removed, and a new one substituted. The small travel of the plunger, and the long spring, combine to give a very fairly uniform pressure of the brush on the commutator in all stages of the life of the brush.

It will be noticed that the carbon brush itself is curved to such a radius that it always occupies the same position of contact on the commutator—an important point, in connection with the sparkless running of the motor. The parts of the holder are neat and substantial, and provision is made for clamping it on the spindle at the proper position and inclination.

So far as a careful inspection of the device can be relied upon as a basis for prophecy, we are of opinion that it will prove satisfactory and reliable in use, and it is difficult to see how it could be tampered with or accidentally damaged, the working parts being entirely enclosed. The clamping piece which holds the carbon in place is an integral part of the casting, and therefore cannot be dropped off or get out of place. We have failed to find any weak point in either the construction or the design of the holder, which is obviously free from the drawbacks of the sliding brush type; moreover, the brush can be worn away until only the small piece required for the grip remains. The device is patented both at home and abroad.

Everett-Edgcumbe "Inkless" Synchronised Recorder.

The chief difficulties met with in the design of a satisfactory recorder are: to overcome the friction between the pen and the paper; to cause the instrument to read correctly, whether the pen is full of ink or nearly empty; to prevent spilling of the ink and consequent blotting of the record; and to provide a satisfactory arrangement for working forward the paper chart.

In the recorder under review, the pen is replaced by a hardened steel point, which does not press on the paper, and thus is quite free to take up its correct position. At equal intervals of time—usually every five seconds—a tapping device causes the steel point mentioned above to press, through an inked typewriter ribbon, on the paper chart. The result is that a dot is produced on the latter, the position of which corresponds accurately to the voltage or current, or whatever is being measured, at that moment.

An additional advantage gained from the construction described above is that a much smaller electrical instrument can be used for measuring purposes. For direct current, a moving-coil instrument is employed, while for alternating currents either the dynamometer type, as in the case of recording wattmeters or recording power-factor indicators, or the moving-iron type for ammeters and voltmeters, is used. For high-tension A.C. circuits the instruments are worked through transformers.

The paper chart is usually supplied in the form of long rolls, lasting a month at 1 in. per hour, which speed can, of course, be varied as required; and, as the paper is passed through the instrument, it is automatically wound up on a drum until required.

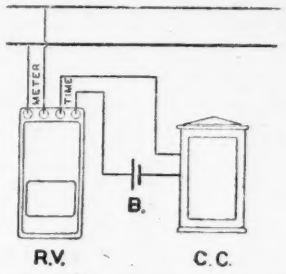


Fig. 15.—Connections of Recorder and Clock, with Battery.

The electric clocks used in connection with these recorders are constructed on the "Hope-Jones Synchronome" principle, and are self-winding, so that no attention whatever is required by the instruments except to change the charts once a month. The currents working the recording system only flow for such very short periods that the energy absorbed is negligibly small, amounting, perhaps, to some 10 ampere-hours per annum per recorder, at 6 volts.

The inking ribbons are in the form of continuous bands, which are advanced slightly at every impression, and only require changing at long intervals.

Fig. 12.—Complete Recorder, with Case Closed.

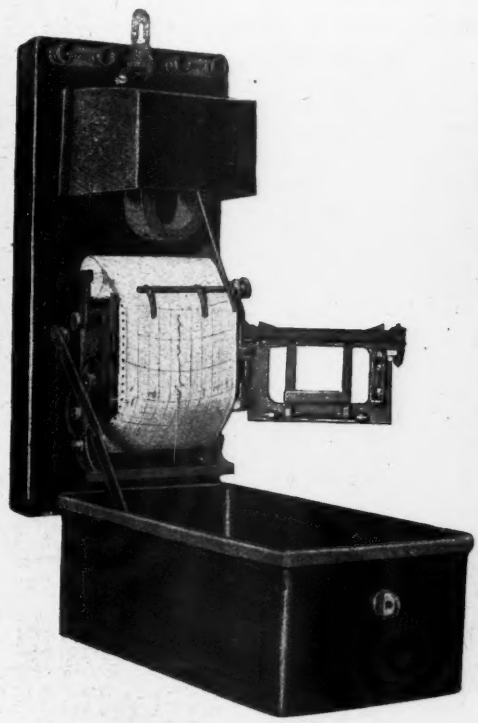


Fig. 13.—Recorder with Case Open, and Tapper Frame Turned Back.

Fig. 14.—Electric Clock.

The intermittent tapping is produced by means of an electrical clock, which closes a circuit every five seconds, and thus actuates an electro-magnet in the recorder itself. A second electro-magnet, in the recorder, at the same time drives the paper chart forward through a definite amount. It may at first sight be thought that an electric contact introduces a complication into the system, but it has been found, after many years' experience, that such electric clocks work without any attention whatever for years, and are, moreover, more accurate timekeepers than the ordinary clock.

A single timing mechanism can be employed to actuate a number of recorders, either a battery or, where available, the supply mains being utilised as a source of current. Also, in series with these recorders, there can be connected any number of clock dials, which not only serve as clocks, but also show at once that the paper charts of all the recorders are timing correctly.

For alternating-current instruments a special astatic moving-iron system is employed, which consists of two "Universal" coils wound in opposite directions, each acting on a separate soft-iron disk. By this means any stray field which may exist in the neighbourhood of the instrument strengthens one coil by the same amount that it weakens the other, so that the effect on the reading is *nil*. In the case of switchboard instruments, the whole is enclosed in a cast-iron case, which forms a further protection, so that the recorders are absolutely unaffected by stray fields, whether the movement be of the moving-iron or the moving-coil type.

The controlling clocks are of two forms, and work either with a pendulum or balance-wheel escapement, according to the use to which they are to be put.

From what has been said it will be seen that practically the same accuracy is attainable with these recorders as with an ordinary

central station indicating instrument, owing to the perfect freedom of the pointer.

The accompanying illustrations show the arrangement of the recorder and controlling clock. The aluminium frame which carries the ribbon

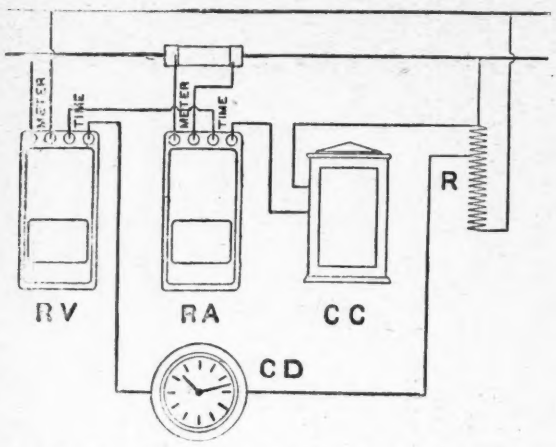


Fig. 16.—Connections of Apparatus with Power from the Mains.

and tapper is inscribed with a scale of volts or amperes, so that the instrument acts also as an indicating meter; and the frame is attached in such a way that it must first be lowered clear of the pointer before it can be turned back on its hinges, thus obviating

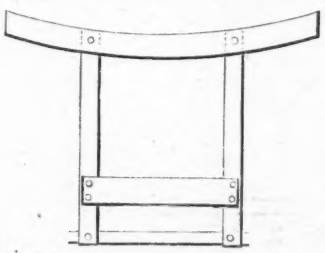


Fig. 17.—Detail of Tapper.

the possibility of injury to the pointer. The latter, moreover, is made of a flexible strip of German silver, so that it can be bent by the tapper without the slightest injury to itself or to the pivots of the moving coil.

The chart is supported behind the pointer by a flat brass plate, and is driven, not by a toothed wheel as is customary, but by a

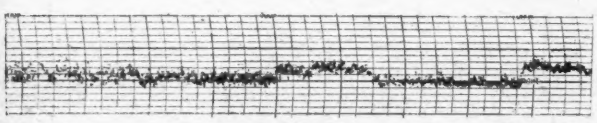


Fig. 18.—"Inkless" Record of Voltage on a Traction Circuit.

chain, each link of which consists of a small brass plate carrying a pin. This arrangement ensures a positive drive without risk of tearing the paper.

The record is not, as might be anticipated, a string of isolated dots; owing to the frequency with which the dots are made, they form a practically continuous record, without the slightest possibility of blurring. The foregoing diagrams, figs. 15 and 16, show how the instrument is connected up, with a battery and with the mains respectively.

New Time Limit Device.

A new time device for use in connection with automatic electric switches has just been brought to our notice; it is being manufactured and put on the market by Messrs. Dorman & Smith, of Ordsal Electrical Works, Salford. This device is intended to delay the operation of opening an automatic overload switch when the current has reached a predetermined value, for a period of time variable according to circumstances, inversely as the excess of the current strength above normal.

There are two chief conditions to be met by such apparatus: in the event of a sudden rush of current, the circuit must be interrupted instantaneously, to prevent excessive mechanical stresses on apparatus connected with it; and protection must also be provided against overheating of apparatus by gradual rise of current strength above the normal value. In the first case a rise of 250 or 300 per cent. above the normal may be taken as a fair value for the point at which the circuit must be instantaneously interrupted, whilst in the second case the safe limit does not depend upon any definite percentage rise of current strength, but upon the actual temperature which has been attained by the apparatus in circuit. A high temperature may be caused by a current much below the limiting value, maintained for a long period, or by a somewhat larger current maintained for a shorter period; or an overload which does

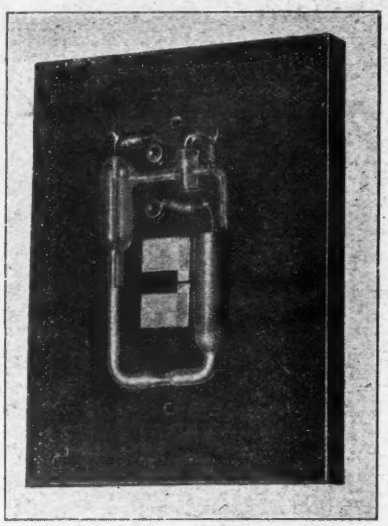


Fig. 19.—Time Limit Device.

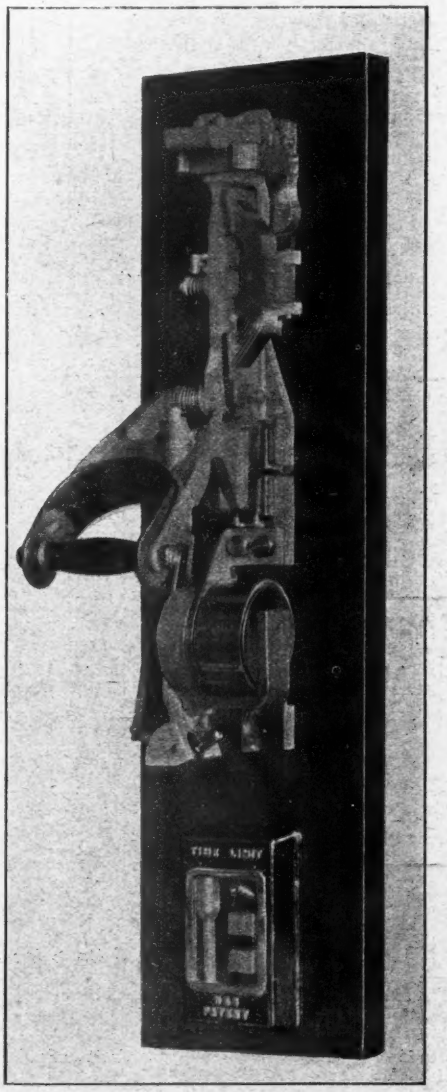


Fig. 20.—Complete Circuit-Breaker combined with Time Limit Device.

not last quite long enough to operate the switch may be succeeded after a short interval by a second overload of much less value, which nevertheless will find the apparatus already at a high temperature, and may therefore lead to its destruction without operating an ordinary cut-out.

It is necessary, then, that the ideal cut-out shall open the circuit when either the maximum safe temperature is exceeded, or (instantaneously) when the maximum safe current is attained; and the device brought out by Messrs. Dorman & Smith is intended to comply with these conditions.

The circuit-breaker has a controlling device provided with two windings, one of which carries the main current, and the control can be adjusted to operate over a considerable range, from 200 to 400 per cent. above normal being sufficient for most ordinary requirements. The second winding is a shunt coil and is connected with the time limit device. At the expiration of the period beyond which the circuit would be heated to a dangerous temperature, the shunt winding on the circuit-breaker control is automatically closed and the circuit-breaker operated.

This time element device is a very compact arrangement, and can be mounted below the automatic switch proper, as shown in fig. 20, on the opposite page. It consists of a glass vessel in the form of two small air chambers with a connecting duct of glass tube. The connecting duct and a part of one air chamber are filled with mercury in such a manner that the mercury can be driven out of one chamber by the expansion of the contained air, through the duct towards the other chamber.

The first air chamber is enveloped by a heating coil or strip forming part of the main circuit controlled by the automatic circuit-breaker. This coil or strip is constructed of resistance metal in such a manner that the heat developed, when it is traversed by a current, is imparted to the air chamber and to the contained air.

This resistance coil or strip is so proportioned, and if necessary, so shunted that the passing of a normal current or a small safe overload will not expand the contained air sufficiently to drive the intermediate mercury to its limit in the duct or second chamber, but if an overload of unsafe value is passing in the circuit, the first chamber will, after a period of time, be sufficiently heated, and the contained air sufficiently expanded to drive the mercury further through, and so to make contact with a platinum-pointed connection which is sealed into the wall of the glass chamber. The closing of this connection by means of the mercury closes the second circuit of the automatic switch control, with the result that the switch is immediately operated.

The expansion of the air in this form of time element occupies a period of time inversely as the current value, and in practical operation, the expansion and contraction of the air in the chamber approximately follow the rise and fall of temperature in the circuit or apparatus connected therewith. By the use of a heating strip the time limit device is bound to have a function almost, if not exactly, in agreement with the rise or fall of temperature in the circuit controlled, and generally this piece of apparatus seems to comply to a high degree with all the requirements of a perfect safety device for protecting electric circuits from injury through overload.

The action of this apparatus is independent of changes of temperature of the surrounding atmosphere, such as occur in an engine room, and the air pressure in the two chambers remains in balance at any temperature so long as change of temperature affects both bulbs equally.

One of the illustrations, fig. 19, shows the timing device with its cover removed, and the arrangement of the two air chambers, one of which is surrounded with a heating strip, can be clearly seen. The other illustration shows a complete Dorman & Smith "grip contact" circuit-breaker for overload control combined with the time element device mounted on the same base. The glass chamber and heater strip are suitably protected by a neat nickel-plated cover with glass front.

(To be continued.)

ELECTRIC TRAMWAY WORKING IN GERMANY.

The tenth annual conference of the Association of German Tramway and Secondary (Light) Railway Administrations was held at Frankfort-on-the-Maine in the second week of September. Among the subjects brought forward for discussion was that relating to favoured treatment on tramways and the ascertainment of the working expenses. Herr Vollguth, the general secretary, who presented a report on the question, submitted that the existing rates for season tickets and workmen's tickets, and the fares for school children, only covered from one-third to three-fourths of the working expenses, and that they were, therefore, inadequate for the purpose. The principle governing the fixing of fares was the same, whether the tramway was in municipal or private ownership, and if a line was to yield any interest on the capital expenditure, the amount should be added to the working expenses, and then embodied in the passenger fares.

Rail Joints.—Herr Busse, of Berlin, who brought forward the problem of rail joints for electric tramways, first referred to the Melaun system and then to the latest method, which was promoted by the Accumulator Co., of Hagen and Berlin. He stated that the process was based upon the development of the heat of an electric arc, which was formed between the rails and a carbon electrode at the welding point, and the necessary current for welding was obtained from the overhead conductor. In the case of the Grand Berlin Tramway Co.'s system, hundreds of joints had been made according to the arc system. In conclusion, the author expressed the belief that a satisfactory solution of the rail jointing question would be arrived at if manufacturers were prepared to make sacrifices, and buyers were to give their support in that direction.

Tramcar Brakes.—Herr Scholtes, of Nuremberg, in dealing with the subject of tramcar brakes, remarked that although in selecting a system, the question of reliability first received the consideration of the tramway administrations, the point of cost was still a material factor. An inquiry made by the author of 95 undertakings showed that most of them used the electric brake, and fewer used the hand brake, while the air brake was rarely employed. The use of the three systems was justified. In his opinion, the braking operation should be free from shock, and should be capable of being accomplished by two brakes independent of each other, but the ordinary working brake should exclude any over-exertion on the part of the driver. If the hand brake was no longer sufficient for heavy cars on falling gradients or where trailers were in service, it was desirable to change over to the electro-mechanical brake. In the case of considerable weights, high speed and the employment of more than two trailing cars, the author concluded that it was scarcely possible to dispense with the compressed air brake for the efficient working of traffic.

The Speed of Cars.—Herr Haselmann, of Aix-la-Chapelle, in a paper discussing the matter of increased speed on tramways, recommended the adoption of the highest speed on lines where the cars had not to cross many roads or to deal with unfavourable gradients; also in streets where there was little traffic, or where the tramways were laid on private land. An investigation of the speed question had been made by the Association with the following result for the interior of the towns where the tramways were situated:—

No. of tramways.	Maximum speed employed.
16	12·40 miles per hour.
27	9·30 " " "
33	7·44 " " "

The highest speed above noted, the author explained, was exceeded on three lines, namely, Frankfort-on-the-Oder, Hagen and Lichterfelde, where the maximum amounted to 15½ miles an hour. On the other hand, six lines only permitted a maximum rate of 5·58 miles per hour in the towns. Outside the towns it appeared that 17 tramways were allowed to use a speed ranging up to 15½ miles an hour, 24 lines a rate of 12·40 miles, and 14 tramways only 9·30 miles on hour.

After discussing other subjects the proceedings terminated, Mannheim being selected as the locale for next year's conference.

The New Mayor of Salford.—Salford is to be congratulated on three fact that Mr. Isidor Frankenburg, of the well-known firm of I. Frankenburg & Sons, Ltd., electric cable and rubber manufacturers of Greengate, Salford, has accepted the office of Mayor for the approaching year. It is always a good thing when men of eminence in manufacturing industries can be induced to give of their valuable experience and time to municipal government, and with Mayor Frankenburg at the helm the year should be a successful one from many points of view in the Salford Council Chamber. Mr. Frankenburg is a man of lengthened experience in municipal affairs, for he became a member of the Salford Council as long ago as 1887. Since 1901 he has been an Alderman, and has recently occupied a seat on the Electricity Committee. We congratulate Mr. Frankenburg on his local popularity.

Mr. Isidor Frankenburg, the New Mayor of Salford.

THE ELECTRICAL EXHIBITION AT OLYMPIA.

On Monday next, September 25th, the Electrical Exhibition at Olympia will be opened by the Lord Mayor of London. It will continue open until October 21st.

The President of the Exhibition, Sir Wm. Preece, being unfortunately abroad, the Lord Mayor and Sheriffs, who will attend in state for the opening ceremony, will be welcomed at the entrance by the chairman of the Executive Committee, Mr. E. Cunliffe-Owen, together with the other members of the executive. The City dignitaries will make a brief inspection of the exhibits, and the Lord Mayor will then, in a few words, declare the Exhibition open. The inaugural lunch will follow, to which the Lord Mayors of York, Liverpool, Manchester and Birmingham, the mayors of the whole of the Metropolitan Boroughs, and a large and distinguished company, have been invited.

The syllabus of lectures arranged by the Institution of Electrical Engineers is as follows:—

Tuesday, Sept. 26th.	Open.	
Friday, Sept. 29th.	"Wireless Telegraphy."	W. Duddell.
Tuesday, Oct. 3rd.	"Development of the Use of Electric Motors."	Col. Crompton.
Friday, Oct. 6th.	"Domestic Lighting."	J. Swinburne.
Tuesday, Oct. 10th.	"Meters."	S. Z. de Ferranti.
Friday, Oct. 13th.	"Telegraphy" (Ordinary)	A. Martin.
Tuesday, Oct. 17th.	"Arc Lighting."	Mrs. Ayrton, M.I.E.E.
Friday, Oct. 20th.	"Telephones."	F. Gill.

In connection with the Cooking Utensil Competitions, the Executive Committee have decided to allot the sum of £100 as prizes, to be awarded as under:—

For the best group of cooking apparatus on exhibition { First prize, £50 / Second prize, £20

For the best single piece of cooking apparatus on exhibition { First prize, £20 / Second prize, £10

A portion of the building has been specially set apart as a kitchen, where an experienced lady lecturer will give practical demonstrations of cooking by electricity.

In the galleries (to which special access has been provided by means of a lift on each side of the centre of the ground floor, which has been erected as a working exhibit by the Easton Lift Co.) will be shown the General Post Office exhibit, the Marconi stand and a large number of interesting trade exhibits, including several rooms which will be wholly devoted to a display of fittings suitable for drawing room, dining room, &c. The Guards Bands will perform from a specially erected stand in the centre of one of the galleries.

The following is a list of exhibitors brought up to date a few days ago by the managers, Messrs. Bridges and Smith:—

Allen, W. H., Son & Co., Ltd.
Amalgamated Dry Batteries, Ltd.
Arc Lamps, Ltd.
Armorduct Manufacturing Co., Ltd.
Avery, W. & T., Ltd.
Babcock & Wilcox, Ltd.
Barker, John, & Co., Ltd.,
Bat Electrical Co., Ltd.
Berliner Telephone Mfg. Co.
Berry, Skinner & Co.
Bonnella, D. H., & Son, Ltd.
Braulik, G.
British Accumulator Co., Ltd.
British Automatic Photograph Co.
British Electric Plant Co., Ltd.
British L. M. Ericsson Mfg. Co., Ltd.
British Prometheus Co., Ltd.
Brockie-Pell Arc Lamps, Ltd.
Bruce Peebles & Co., Ltd.
Brush Electrical Eng. Co., Ltd.
Burt, N., & Co., Ltd.
Callender's Cable and Construction Co., Ltd.
Cape Asbestos Co., Ltd.
Chameleon Signs, Ltd.
Cory Bros. & Co., Ltd.
Cowans, Ltd.
Crompton & Co., Ltd.
Crossley Bros., Ltd.
Crypto Electrical Co.
Darton, F., & Co.
Davis Patent Boiler, Ltd.
Defries, J., & Son.
Dellagana, B., & Co., Ltd.
Diesel Engine Co., Ltd.
Dorman & Smith.
D.P. Battery Co., Ltd.
Dowsing Radiant Heat Co., Ltd.
Drake & Gorham.
Edison & Swan United Electric Light Co., Ltd.
Elandem Co.
Electrical Corporation.
Electric and Ordnance Accessories Co., Ltd.
Electrical Magazine.
Electrical Power Storage Co., Ltd
Electrical Review.
Electrical Times.
Electrician.
Electricity.
Electrical Press.
Electrophone Co.
Electromotors, Ltd.
Elliott Bros.
Escare & Denelle.
Everett, Edgcumbe & Co.
Falk, Stadelmann & Co., Ltd.
Ferranti, Ltd.
Foxcroft & Duncan.
Frankenburg, I., & Son, Ltd.
Fricker & Miller.
Frictionless Engin Packing Co.
Hunter Electric Candle Lamp Co., Ltd.
International Electric Co.
Kaye, Joseph, & Sons, Ltd.
Keith, Jas., & Blackman Co., Ltd.
Key Engineering Co., Ltd.
Klein Engineering Co., Ltd.
Lahmeyer Electrical Co., Ltd.
Lancashire Dynamo and Motor Co.
Langdon-Davies Motor Co., Ltd.
Le Carbone.
Linolite Co.
Lister Electric Manufacturing Co.
Lithanode Electric Storage.
London Electrical Fittings Co., Ltd.
Longstreths, Ltd.
Lucy, W., & Co., Ltd.
Lundberg, A. F.
Maple & Co.
Marconi Wireless Telegraph Co.
Marryat & Place.
Maxim Electrical Co., Ltd., Sir Hiram McGeoch, Wm., & Co.
McPhail and Simpson Dry Steam Patents Co., Ltd.
Metropolitan Electric Supply Co., Ltd.
Monté-Callow & Co.
Morris Hawkins Electrical Co., Ltd.
Morgan Crucible Co., Ltd.
Mountain & Gibson, Ltd.
Nalder Bros. & Co.
Nalder Bros. & Thompson, Ltd.
National Gas Engine Co., Ltd.
National Telephone Co.
New Brotherton Tube Co., Ltd.
Oliver & Co.
Oliver Clark & Co.
Oliver Typewriter Co., Ltd.
Ozonair, Ltd.
Paul, Robt. W.
Pearn, F., & Co.
Pearson Fire Alarm, Ltd.
Phœnix Dynamo Mfg. Co., Ltd.
Pope's Electric Lamp Co.
Portable Accumulators, Ltd.
Price's Patent Candle Co., Ltd.
Pritchetts & Gold, Ltd.
Reason Manufacturing Co., Ltd.
Reyrolle, A., & Co., Ltd.
Rhodes, J., & Sons, Ltd.
Robertson Electric Lamps, Ltd.
Rumley & Rumney.
Santoni, D., & Co., Ltd.
Schiff & Co.
Selig, Sonnenthal & Co.
Shaw, Lennard.
Shoobred & Connell.
Siemens, Bros. & Co., Ltd.
Simplex Steel Conduit Co., Ltd.
Spagnoletti & Co.
Standard Metal Engraving Co.
Steel-Core Concrete Co., Ltd.
Steel, Peech & Tozer.
Fuller, J. C., & Sons.
Fuller-Wenström Electrical Mfg. Co.
Geipel & Lange.
General Electric Co., Ltd.
General Post Office.
Globe Wernicke Co., Ltd.
Gloyer, W. T., & Co., Ltd.
Green, E., & Son, Ltd.
Haines & Co.
Halden, J., & Co.
Hands, A. C.
Hart Accumulator Co., Ltd.
Hart Manufacturing Co.
Henley's Telegraph Works Co., Ltd.
Hentschel, Carl, Ltd.
High-speed Braiding Machine Co., Ltd.
Hindley, E. S., & Sons.
Hobdell, Way & Co., Ltd.
Howard Bros.
Howard & Jones.
Hunt & Hess.
Stewart & Lloyds, Ltd.
Stockall, J. J., & Sons, Ltd.
St. Pancras Borough Council.
Straus, G., & Co., Ltd.
Sturtevant Eng. Co.
Sunbeam Lamp Co., Ltd.
Switchgear Co., Ltd.
Temperley Transporter Co.
Theermann, W. P., & Co.
Trading & Manufacturing Co., Ltd.
Tramway and Railway World.
Traun, Dr. Heinr, & Sons.
Tucker, J. H., & Co.
Tudor Accumulator Co., Ltd.
Union Cable Co., Ltd.
Union Electric Co., Ltd.
Veritys, Ltd.
Vickers, Sons & Maxim
Walker, W. G., & Co.
Wandsworth Electrical Mfg. Co, Ltd.
Western Electric Co.
Wright & Co., A. P.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

13,093A. "Improvements in or relating to electric drills." A. J. Boult. (W. O. Duntley, United States.) (Date applied for under Rule 5 of the Patents Rules, 1905, June 24th, 1905.) September 7th. (Complete.)

13,093B. "Improvements in or relating to switches for electric drills." A. J. Boult. (W. O. Duntley.) (Date applied for under Rule 5 of the Patents Rules, 1905, June 24th, 1905). September 7th. (Complete.)

17,814. "Improvements in apparatus for controlling or supplying current for power and light on consumers' premises during certain periods." G. S. Ellis and A. M. Taylor. September 4th.

17,818. "Improvements in electric cable conduits." W. Higgins. September 4th.

17,826. "Improvements in electric clock systems and the like." I. H. Parsons and A. E. J. Ball. September 4th.

17,835. "An improved form of electrical contact-breaker." E. Payne September 4th.

17,838. "An improved trolley head for electric tramways and railways." A. T. Eardley. September 4th.

17,843. "Improvements in and relating to electric motors especially intended for hoisting and similar purposes, and in systems of control therefor." British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) September 4th.

17,873. "Improvements in signalling by electro-magnetic waves." C. J Briggs. September 4th. (Complete.)

17,878. "Improvements in insulators for current-carrying rails of electric traction systems." A. Watkins. September 4th.

17,881. "Improvement in electric securing devices for doors and the like." O. Roeseke. September 4th. (Complete.)

17,888. "Improvements in combined electric switches and automatic circuit breakers." J. H. Holmes. September 4th.

17,895. "Improvements relating to electrical ignition systems for internal combustion engines." The Electric Ignition Co., Ltd., and F. H. Hall. September 5th.

17,896. "An improved electrical generator system for use in connection with automobiles and the like." The Electric Ignition Co., Ltd., and F. H. Hall. September 5th.

17,955. "Improvements in electrical relays." C. G. Roos and C. B. Roos. September 5th. (Complete.)

17,956. "Improvements in or relating to direct-current electric motors." W. P. Thompson. (G. McAlpine, Mauritius.) September 5th.

17,957. "Improvements in step-by-step electric switches especially applicable as line selectors." I. B. Birnbaum and H. G. White. September 5th.

17,974. "Improvements in joints for electric cables." Siemens Bros. & Co., Ltd., and E. M. A. Neale. September 5th.

17,990. "Railway automatic or electrical danger signal, to be worked by a treadle or electric bar." J. I. J. Lee. September 6th.

17,996. "A new or improved device for use in supporting electric cables, pipes, rods or the like." F. Mitchell and F. Gunn. September 6th.

17,997. "Improvements in or relating to electric insulators." T. Cushing. September 6th.

18,006. "Improvements in or relating to electric fans and the like." R. P. Wilson and A. G. Marshall. September 6th.

18,013. "Improved means of rectifying alternating electric currents." F. S. Povah and S. G. Livett. September 6th. (Complete.)

18,016. "Improvements in connectors for electric cables." E. C. Lea. September 6th.

18,044. "Improvements relating to electric lampholders." J. Paterson. September 6th.

18,051. "Improvements in and connected with current takers or trolleys for overhead wires of electric railways and the like." O. Hoffmann. (Date applied for under Patents Act, 1901, September 9th, 1904, being date of application in Germany.) September 6th. (Complete.)

18,053. "Improvements in brush-rocking gear for dynamos." H. Leitner and R. N. Lucas. September 6th.

18,076. "Improvements in accident-preventing or life-saving apparatus for electric tramcars and like vehicles." T. A. Bennett. September 7th.

18,089. "Installations of electrical clocks for public, domestic and general use." E. L. Hunt. September 7th.

18,102. "Improvements in transmitters for automatic telegraph systems and the like." J. Gell. September 7th. (Complete.)

18,118. "Improvements in cross-over points for the overhead electric conductors of trolley traction systems." A. H. Holmes and H. W. Holmes. September 7th.

18,126. "Improvements in electric train control systems." A. Sundh. September 7th. (Complete.)

18,144. "A thermo-electric generator." J. Lecoche. September 7th.

18,147. "Improvements in commutators for electric ignition of gases in internal combustion engines." G. W. Somerville and O. Hicks. September 8th.

18,148. "Improvement in self-propelled electrical motor-car or vehicle." L. Collender. September 8th.

18,155. "Electro-magnetic selective separator." S. R. Bottone and D. Crosse. September 8th.

18,188. "Improvements in sparking plugs particularly for use with internal combustion engines." R. Broadbent. September 8th.

18,193. "Improvements in microphones or telephone transmitters." F. Treyer. (Date applied for under Patents Act, 1901, February 15th, 1905, being date of application in Switzerland.) September 8th. (Complete.)

18,208. "Improved contrivance for truing the surfaces of commutators." E. B. Phillips and T. C. Parkin. September 8th.